Offshore Wind Energy
Inspection Procedure Assessment
Final Report

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Acronyms

ABS	American Bureau of Shipping
ABSG	ABS Group
AIS	Automatic Identification System
ALARP	As low as reasonably practicable
ANSI	American National Standard Institute
AWEA	American Wind Energy Association
BAST	Best Available and Safest TechnologY
BetrSichV	Betriebssicherheitsverordnung (Industrial Safety Ordinance)
BGI	Berufsgenossenschaftlichen Information
BOEM	Bureau of Ocean Energy Management
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
BOSIET	Basic Offshore Safety Induction and Emergency Training
BOWTI	Bottom-founded Offshore Wind Turbine Installations
BS	British Standard
BSEE	Bureau of Safety and Environmental Enforcement
BSH	Bundesamt für Seeschifffahrt und Hydrographie (Federal Maritime and Hydrographic Agency)
BSI	The British Standards Institution
BWE	German Wind Energy Association
BWEA	British Wind Energy Association
CalWEA	California Wind Energy Association
CanWEA	Canadian Wind Energy Association
CCTV	Closed Circuit Television
CDM	Construction Design and Management (UK)
CE	Conformité Européenne (CE mark)
CM	Condition Monitoring
CMS	Condition Monitoring System
COP	Construction and Operations Plan
CREIA	Chinese Renewable Energy Industry Association
CWEA	China Wind Energy Association
CWIF	Caithness Wind Farm Information Forum
DGUV	Deutsche Gesetzliche Unfallversicherung e.V. (German Statuatory Accident Insurance)
DNV	Stiftelsen Det Norske Veritas
DNVGL	Stiftelsen Det Norske Veritas and Germanischer Lloyd
DOI	Department of the Interior
DSS	Distributed Strain Sensing
DTS	Distributed Temperature Sensing
DWIA	Danish Wind Industry Association
EU	European Union
EWEA	European Wind Energy Association

FA	Fall Arrest
FEPA1	Food and Environment Protection Act 1
FOWTI	Floating Offshore Wind Turbine Installations
G9	G9 Offshore Wind Health and Safety Association
GAP	General Activities Plan
GL	Germanischer Lloyd
GWEC	Global Wind Energy Council
HDD	Horizontal Direct Drilling
HSE	Health and Safety Executive
HVAC	Heating, Ventilation and Air Conditioning
IAC	Internal Arc Classification
ICC	Incident Contact Centre
IEA	International Energy Agency
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IP	Ingress Protection
IPAF	International Powered Access Federation
IRATA	International Rope Access Trade Association
IWEA	Irish Wind Energy Association
JG	Japanese Government
JWPA	Japan Wind Power Association
LOLER	Lifting Operations and Lifting Equipment Regulations (UK)
LVAC	Low Voltage Alternating Current
LVDC	Low Voltage Direct Current
m	Meter
m/s	Meters per Second
MCA	Maritime Coastguard Agency
METI	Ministry of Economy, Trade and Industry
MEWP	Mobile Elevating Work Platform
N/A	Not applicable
MMS	Minerals Management Service
MP	Monopile
MW	Megawatt
MWS	Marine Warranty Survey
NORSOK	Norsk Sokkels Konkuranseposisjon
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf lands Act
OFGEM	Office of Gas & Electricity Markets (UK Government)
ONWF	Onshore Wind Farm
OSHA	Occupational Safety and Health Administration
OSP	Offshore Substation Platforms
OTDR	Optical Time Domain Reflectometer

OWA	Offshore Wind Accelerator
OWF	Offshore Wind Farm
O&M	Operation and Maintenance
PAL	Powered Access License
PD	Partial Discharge
PPE	Personal Protective Equipment
PSSR	Pressure Systems Safety Regulations (UK)
PST	Product Sample Test
PTW	Permit to Work
PUWER	Provision and Use of Work Equipment Regulations 1998 (UK)
RAMS	Risk Assessment Method Statements
RAT	Rope Access Technique
RBI	Risk-Based Inspection
RIDDOR	Reporting of Injuries, Diseases and Dangerous Occurrences Regulations
RISE	Renewable Industry Safety Exchange
RNA	Rotor-Nacelle Assembly
ROAV	Remotely Operated Aerial Vehicles
ROV	Remotely Operated Vehicle
RP	Recommended Practice
RPE	Respiratory Protective Equipment
RTM	Real-Time Monitoring
R&D	Research and Development
SAP	Site Assessment Plan
SCADA	Supervisory Control and Data Acquisition
SHE	Safety, Health and Environment
SDWEA	South Dakota Wind Energy Association
SPD	Surge Protection Device
SWL	Safe Working Load
TA&R	Technology Assessment & Research
TP	Transition Piece
TT	Type Test
UK	United Kingdom
UPS	Uninterruptible Power Supply
U.S.	United States
USCG	United States Coast Guard
UT	Ultrasonic Test
UXO	Unexploded Ordnance
VAR	Volt Ampere Reactive
WBV	Whole Body Vibration
WLL	Working Load Limit
WTG	Wind Turbine Generator
WWEA	World Wind Energy Association

Executive Summary

This report is a survey of inspection regulations, standards and practices for the offshore wind industry. The wind power industry is a particularly higher risk industry in onshore locations, and the risks are only higher when you shift to an offshore environment.

The offshore wind power industry is at an early stage here in the US. The first projects are set to put their first 'Steel in the Water' later this year. While the future of offshore wind is uncertain due to economic and other external forces, the potential is quite high from a resource and demand perspective. There is a great deal of strong wind resources very close to high demand centers on both coasts. As costs come down, and if the economic factors surrounding wind power improve, offshore wind energy could become a major source of energy for the US in the future.

The UK is in a unique position to serve as an example in many areas to aide in the scope of this report. They have an active, ongoing and robust presence in the offshore wind industry. They also have a very strong regulatory environment which is similar to the US's regulatory environment. Therefore, in this report there is a greater focus on the UK as the prime example of BAST for inspections, evaluations and audits practice.

Please note that the recommendations are placed at the front of this report with the deeper analysis further on. Section two is a review of current regulations and standards relevant to offshore wind power in general and inspection in particular. Section three covers the various health, safety and environmental issues facing the offshore wind industry. Section four covers the approaches BSEE should undertake towards inspection of OWF.

BSEE is poised to shepherd and steward this expansion and growth in energy in a safe and efficient manner. The information and recommendations provided in this report should assist BSEE to achieve this goal.

Introduction

Since the first United States (U.S.) Offshore Wind Farm (OWF) project, "Cape Wind," received federal, state, and local permitting and approval in 2009, other developers have started to go through the approval process to install OWFs in the East Coast, Gulf of Mexico, and Great Lakes in the U.S. Following those developments in the offshore wind energy sector, the Bureau of Safety and Environmental Enforcement (BSEE) decided to engage the ABS Group (ABSG) to review Outer Continental Shelf (OCS) wind farm inspection procedures based on current domestic and international OWF and Onshore Wind Farm (ONWF) regulations, standards, and inspection practices in countries where OWF and ONWF have been long in operation. The countries that are included in this study are the United Kingdom (UK), Germany and Denmark for both OWF and ONWF inspection practices and the U.S., Canada, Japan, Bulgaria, Switzerland, Italy and China for onshore wind farms inspection practices. Those countries are the current leaders in regulatory oversight of offshore and onshore wind operations. In this study, relevant European Union (EU) regulations and international standards are also reviewed.

With the amendments in the Outer Continental Shelf Lands Act (OCSLA) in 2005, the Department of the Interior (DOI) was granted with the authority to regulate offshore renewable energy activities, in addition to offshore oil and gas activities. As stated in OCSLA, it is the policy of the U.S. that, "*operations in the Outer Continental Shelf should be conducted in a safe manner by well-trained personnel using technology, precautions, and techniques sufficient to prevent or minimize the likelihood of blowouts, loss of well control, fires, spillage, physical obstruction to other users of the waters or subsoil and seabed, or other occurrences which may cause damage to the environment or to property, or endanger life or health.*" Based on this policy, DOI has the same responsibility to ensure the safe and prudent development of OCS wind energy resources. Consequently, BSEE will exercise the same authority, granted to it by the Secretary of the Interior, to ensure safe and environmentally sound operations of OWFs, as it has for offshore oil and gas exploration, development, and production operations. Based on this information, ABSG conducted this study and documented relevant OWF and ONWF inspection, audit and evaluation practices in countries where wind farm development experience is advanced.

It is stated in the Special Report 305, Structural Integrity of Offshore Wind Turbines[1] that, "*risks to human life from the structural failure of offshore wind installations is limited in comparison to risks from other offshore facilities, such as oil and gas platforms and marine vessels, as offshore wind turbines are normally unmanned posing limited risk to human life*." The report goes on to state that, "*the most dangerous element in offshore wind farm activities involves the transfer of personnel to wind turbines for installation, commissioning and inspection/maintenance by boat or helicopter*." While those statements are correct, it is also important to remember that the advancement in wind energy technology have enabled developers to go into deeper waters with higher megawatt (MW) wind turbines mostly accompanied by Offshore Substation Platforms (OSP). In addition, novel foundation designs, floating Wind Turbine Generator (WTG) designs and utilization of more than one export cable in new generation

[1] Special Report 305, Structural Integrity of Offshore Wind Turbines, page 63, Transportation Research Board of National Academies, Washington, D.C., 2011

OWF projects have introduced new occupational safety and environmental risks in practices involving transportation, installation, commissioning of offshore foundations, WTGs, OSPs, array cables and export cables and successive OWF operations and maintenance practices. As addressed in this study, while the most of occupational safety risks stem from transportation and installation activities of OWF components including subsea cables and OSPs, the main environmental risks of those activities are posed by vessels, installation of monopile (MP) foundations and poor maintenance practices offshore. Relevant chapters will address relevant inspection regulations specifically written to mitigate the environmental risks such as fuel leak from a transportation or service vessel, release of transmission fluid or other hydrocarbon-based liquids from the wind farm structures, noise emitted by pile- driving when installing MP foundations, disturbance to sea mammals during the installation of OWF components, threat to bird life (particularly during migration periods) and bats, and breach of consent requirements.

Because the environmental and occupational safety risks of OWF facilities are deemed to be relatively low, the Special Report 305[2] questions the form and extent of government regulation in this field. Report goes onto suggest that if there are smaller safety and environmental risks associated with structural failure of an OWF, then a natural question to ask is whether the financial and insurance risk assumed by the developer is sufficient for regulating the industry. Although there is much truth about what is said in that report about the environmental risks posed by OWFs, the same cannot be said for the occupational safety, as there are significant number of accidents and fatalities both in OWF and ONWF construction and operations phases. For that reason, there is no question about the needs to regulate the OWF and ONWF design, construction and operation practices to ensure safe operations for people, property and the environment.

Both OWF and ONWFs require competent engineers, technicians and other subject experts to carry out their respective activities safely throughout the full life-cycle of wind farm assets covering design, construction, operation, and decommissioning phases. The key word is the competency; as each person working on wind farm projects, whether at design phase or operation phase, should have the requisite safety training with an objective of ensuring safety for people and the environment in order to become competent in the field of safety. In other words, a competent person is someone who has sufficient training and experience or knowledge and other qualities that allow them to assist the wind farm owner or operator properly. The level of competence required will depend on the complexity of the situation and the associated risks. It should be noted that the qualifications and duties of a “competent person” can vary by jurisdiction.

As stated in the Special Report 310 – Worker Health and Safety on Offshore Wind Farms,[3] although the Federal Government has regulated the production of offshore oil and gas for decades, it has no

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[2] Special Report 305, Structural Integrity of Offshore Wind Turbines, page 65, Transportation Research Board of National Academies, Washington, D.C., 2011

[3] Special Report 310 - Worker Health and Safety on Offshore Wind Farms , page 2, Transportation Research Board of National Academies, Washington, D.C., 2013

experience with OWFs. According to this report, *"Onshore and offshore wind farm developments share many of the same tasks and risks; however, the challenge of working on and from vessels and in and over the water with massive offshore wind turbine equipment introduces additional hazards and different risks. The oil and gas and wind industries share most of these offshore hazards, but overall, the risk associated with oil and gas hazards is greater than that associated with offshore wind. In this context, workplace 'risk' is viewed as the product of the probability and the consequence of a hazardous event. The oil and gas industry works with a more volatile product, so the risk of explosion or fire on offshore platforms is greater than on offshore wind turbines."* This statement is certainly valid in a general sense. However, for some activities during the transportation and construction phases of wind farm development, the associated risks can be very high. This is particularly true for deployment and installation of OWF components, such as foundations, WTGs and OSPs.

This study reviewed relevant safety regulations of various countries which led the OWF and ONWF development over the last two decades, EU regulations and international standards in order to identify and prioritize OCS wind farm inspection procedures. The recommendations that flow from the report has been gathered and summarized in the first section. All relevant state, national, international regulations and standards associated with OWF/ONWF and wind turbine inspections/audits/evaluations are reported in the second section. The major safety and environmental concerns for the operation of OWFs are examined in order to identify the critical structures and components that should be subject to inspections. These are listed in the third section. A list of possible approaches to OWF regulations and inspections was constructed that describe different roles which BSEE could fulfill based on the assessment of the wind energy regulatory landscape performed in the second and third section. There are extensive appendices which background information. Some of these appendices are lists of relevant codes, regulations and standards from various countries that are reviewed in the second section.

1. Recommendations

1.1. Phases of WTG lifecycle

During different times in the lifecycle of the OWF, there will be different priorities, levels of activities, goals, and associated risks. So before going any further, it is prudent to discuss these phases of the life cycle.

1.1.1. Design and component manufacturing

The design phase will have little direct safety and environmental risks associated with. Oversight of this stage is primarily focused on verifying that all parties are utilizing good design and standards in the design of the turbine, components and the project site itself. These activities are carefully monitored by both the type certification and project certification process. It is recommended that BSEE review all official materials from the type and project certification process.

The exception to the above statement would relate to any activity on the project site in the process of collecting data during the early project design phase. This would include activities such as metocean data gathering, core sampling, sea floor mapping, etc. This is especially true if a permanent met-mast is installed as part of the data gathering for the design phase. A permanent met-mast will be much like a mini OWF process nested within and early on in the bigger OWF process.

The documents which describe the installation, commissioning and O&M procedure should be reviewed by BSEE at this stage. These plans should include safety procedures and valid training certificate requirements for all activities.

1.1.2. Transportation

It is recommended for BSEE to require inspections on WTG component transportation to reduce risk of incidents and accidents. The transportation inspections should be carried out by competent third party inspectors at random to ensure that all wind farm onshore transportation activities involving selection of correct transportation tools such as saddles for tower transportation etc., lifting, loading, unloading are done correctly to prevent accidents in the process. These inspections are required of the CVA process, so it is further recommended that review of the reports generated by the CVA be sufficient to satisfy this requirement.

1.1.3. Installation and commissioning

It is recommended that BSEE verifies that OWF owners have assigned a third party CVA to carry out inspection of installation procedures covering foundation, transition piece, WTG components, subsea cables, OSP foundation and topside. The inspectors should check the installation procedures, which must be prepared by a construction team based on WTG and site specific conditions; each installation activity should be risk assessed and all installation risk should be reduced as low as reasonably practicable. Any reports that are generated shall be forwarded directly to BSEE without any editing or redacting by any party. It is prudent that BSEE reserves the right to evaluate and audit the process to verify that the inspections are being conducted in a correct and timely manner and without hindrance or delay from either party.

It is further recommended that BSEE requires OWF owners to also assign a third party CVA to carry out inspections on OWF and related onshore construction activities to ensure that the each activity is properly planned and risk assessed, all risk mitigation plans are carried out, correct safety procedures are put in place and implemented consistently throughout the construction phase of an OWF and ONWF. This work shall include WTG component assembly onshore and offshore, diving operations, sea-fastening and rotor blade installation as well as installation of Met-Masts, OSPs and subsea cables to ensure safe practices throughout the construction phase.

1.1.4. Operations and Maintenance

It is required by federal regulation that owner/operators have an annual inspection as part of the regular operation and maintenance process. The owner/operator shall have an O&M plan which has been reviewed and certified during the project design phase. As stated earlier, that plan shall include safety procedures and valid training certificate requirements for all O&M activities. It is recommend that BSEE require from the owner/operators a written report be generated which records the certificates of the workers/inspectors, description of the work done and any relevant incidents or anomalies. These records should be kept and available for auditing by BSEE or a designated third party inspector for the life of the project.

It is recommended that BSEE require owner/operators to have continuous inspections applied annually to a minimum of 20% of the Offshore Wind Substructure installations in the OWF combined with a condition monitoring program where in minimum 10% of the offshore wind turbines are equipped with suitable CMS.

1.1.5. Life extension and repowering

It is very possible that the OWF could see either a life extension or repowering stage before decommissioning. Life extension entails keeping the major components and performing the necessary overhaul to squeeze more years of service from the OWF. Repowering entails replacing major components of the OWF, such as the Rotor Nacelle Assembly, while keeping (with overhaul) the balance of plant.

It is recommended that BSEE account for the possibility of life extension and repowering. BSEE should consider reviewing the relevant data and reports used to make the decision to repower or extend the life of the project. This will be especially true if a CVA is not active in the process. The phase can be thought of containing all of the other phases of life compressed into one. For there will be design aspects in which the current state of the OWF is evaluated. Certain portions of the OWF will be subject to replacement, and those parts go through a decommissioning process. And then the replacement components are shipped, prepared, installed and commissioned.

1.1.6. Decommissioning

In section 3.17, decommissioning is covered in further detail. It is recommended that BSEE require from owner/operators a preliminary decommissioning plan set forth during the project design phase. The decommissioning plan should be reviewed by BSEE with relevant authorities for approval. Decommissioning operations should be supervised by a BSEE or an approved third party, and if necessary BSEE should initiate inspections to ensure that disassembly of all OWF components are carried out in accordance with approved code of practices and that dismantled pieces are recycled or disposed in accordance with applicable regulations.

1.2. Worker Safety

1.2.1. Safety Management System

BSEE must inspect the safety management system as per as required in § 585.810. Periodic inspections should be carried out to assess the validity and adequacy of the safety management system including safety organization, safety procedures, communication of safety plan and procedures to wind farm construction team or O&M team or contractor. Safety inspections should include the review of work instructions, RAMS, safety training records, medical fitness records and competency records. Refer to section 3.8 for further detail.

It is recommended that BSEE review the Global Wind Organization - Basic Safety Training – Standard[4] (reference section 4.7.13) as an example of worker training standards for the safety management system.

1.2.2. WTG Access

Offshore Transportation and Boat Landing: Periodic inspections/audits need to be carried out to ensure that transportation method and boat landing procedure are adequate for the OWF site conditions and those they are implemented correctly. The following four different WTG accesses can be used taking into consideration that access is not always possible because of offshore weather conditions: (a) direct landing by use of vessel, (b) boat landing with motion compensation, (c) crane hoist and (d) helicopter (more suitable for OSPs rather than WTGs). Refer to section 4.7.9 for further details.

1.2.3. PPE and Fall Protection

Safety equipment must be inspected after it has been installed, and before being put into use for other activities later in the construction or subsequent phases of OWF and ONWFs. PPE must be regular inspected by the users and the operator/owner of the wind farm regularly to ensure that PPE is fit for purpose and also used properly. The relevant PPE procedures such as "buddy checks" of each other's PPE prior to commencement of a task can help to fulfil this duty should also be reviewed for their validity and accuracy. Refer to sections 2.1.3-5, 3.6.5, 3.8 and 4.7.7 for further detail.

1.2.4. Walkways, Ladders, Lifts

Ladders: Internal and external ladders must be inspected in regular intervals by competent person or third party inspectors. The inspection should focus on the ladder's structural integrity and the surface upon which a ladder rests; the surface should be stable, firm, of sufficient strength and of suitable composition to support the ladder safely, so that its rungs or steps remain horizontal with any loading intended to be placed on it. Refer to section 2.1.5 for the UK requirements.

Lifting Equipment and Tools: Statutory inspections need to be carried out for lifting equipment and tools in accordance with the regulatory requirements. Inspections should focus on adequateness and accuracy of the lifting work procedure (safe working procedures must be drawn up for each lift installation), risk assessment, which must be made to identify hazards associated with work on each lift installation, previous lifting activity records and training certificates of personnel who use lifting equipment. Refer to section 2.1.1.1 for the UK requirements.

1.2.5. Confined Space

Inside the rotor blade and the area below the airtight deck of offshore wind turbine foundation are classified as confined space. As the confined space can be deadly, it is recommended that BSEE require

[4] Global Wind Organization Standard – Basic Safety Training (BST) (Onshore/Offshore) , 2014

http://www.windpower.org/download/2277/GWO_BST_Standard_Version_6%2C_12_March%2C_2014.pdf that the wind farm owners and operators are following hierarchy of controls prior to commencing inspections and maintenance practices below the airtight deck of an OWTG foundation and in a rotor blade of a WTG:

a. Assess whether inspection can be done in another way to avoid entry into confined space
b. If entry to a confined space is unavoidable, follow a safe system of work
c. Only allow working in confined space for people
    i. With valid confined space training certificate
    ii. With adequate PPE
    iii. Who is fit to carry out work in a confined space
d. For rotor blade inspections, only allow inspections if the rotor blade diameter is larger than 550 mm.
e. Carry out risk assessment method statements and put in place adequate emergency arrangements before the work starts
f. The main danger is untested atmosphere which may be oxygen deficient or contain atmospheric contaminants; if that is the case ventilate the confined space by opening the hatch in advance of inspections and use respiratory protective equipment.

Therefore it is recommended that BSEE or their designated third party inspectors to use random inspections and audits to verify whether the wind farms operators are following the procedure outlined above prior to commencement of any works in a confined space within a wind farm.

1.2.6. Competent Person Concept in the UK

In the UK, they have a concept of Competent Person which is hired by the OWF owner/operators and manages HSE activities for the company. The view of the UK HSE is that the decision on “competency” should lie with the companies hiring their own HSE specialists or assigning third parties to carry out HSE inspections, audits, reviews, etc. It is recommended that BSEE review “Benchmarking the Competent Person in Manufacturing and Engineering Sectors” issued by the UK HSE, before deciding whether to adopt the same approach or to be prescriptive in this area

1.2.7. Electrical Hazards

Electrical hazards are a major source of severe accidents in the wind industry. Many of these accidents have been due to insufficient training of workers on working with high power electrical devices. Refer to section 4.7.14 for suggested training protocols which should be incorporated into worker training requirements.

1.2.8. Diving

It is recommended that BSEE require all OWF owners/operators to prepare Risk Assessment Method Statements (RAMS) prior to any maintenance or inspections works, which need to be carried out by divers. The RAMS must adequately address all risks inherent in relevant subsea maintenance and inspection activities and all risk mitigation plans must be put in place well in advance. RAMS must be prepared and peer-reviewed by competent people.

1.3. Structural

It is recommended that BSEE consider having OWF owners implement structural integrity monitoring systems to be utilized for cost effective and proactive monitoring particularly for the structural integrity of tower, TP and the foundation. Also, condition monitoring of the major rotary components should be included in this scenario. These monitoring techniques may be novel but they should be considered as oppose to traditional inspection techniques due to their ease of access and increasing sophistication of these tools. Refer to section 3.14 for further detail on this subject.

While the subsea structural components do not need the same frequency of inspections as those above water, they do need occasional inspections to monitor structural health, bioaccumulation, corrosion and scour protection on the foundation. Refer to section 2.10 for further detail on this subject. It is recommended that BSEE consider ROV systems as an alternative solution for these occasional visual inspections of subsea components. It should be remembered that underwater inspections carried out by divers present major safety risks, hence utilizing such CM and ROV systems for the foundations and transition pieces will eliminate the safety risks involved in diving practices.

It is further recommended that BSEE to ensure that all relevant technical inspections and document reviews of maintenance practices on mechanical and structural components are carried out whether by wind farm operators or by third party inspection companies.

1.4. Environmental Inspections

It is recommended that BSEE ensure that the following inspections, audits or evaluations are carried out during installation and commissioning phases of OWF, OSP and Met-Mast in order to prevent damage to the environment. It is further recommended that BSEE or an approved third party inspect the maintenance procedure and practices in accordance with the turbine manufacturer's O & M plan to ensure that the owner/operator is taking all possible precautions to minimize the environmental risks.

1.4.1. Pile Driving

It is recommended that BSEE or an approved third party inspector monitor activities to ensure that pile driving activities are carried out in accordance with consent requirements. The underwater sound pressure caused by pile-driving may be harmful to fish and marine mammals during the OWF foundation installations. Therefore, state and local regulatory agencies make demands on OWF developers regarding environmental issues associated with pile-driving, and outline the relevant requirements within the permit, which is issued following review of OWF environmental impact report.

1.4.2. Fire

It is recommended that BSEE or an approved third party inspect the drive train and electrical components/cables, as well as the OSP, for possible fire hazards. They should look and record any wear or degradation that could leads to a fire. Lubricants, coolants and other debris scattered from the burning nacelle present risks to environment and wild life.

1.4.3. Rotor Blades

It is recommended that BSEE to work with the state and local authorities to ensure that wind farms are approved after adequate bird surveys carried out within environmental impact assessment (EIA). Rotating rotor blades may cause bird deaths when WTGs are in operation. While there is not much to be done to prevent such environmental impact of the WTGs in operational phase, there are possibilities to reduce this environmental impact in the design stage of OWFs and ONWFs.[5].

1.4.4. Water Pollution

It is recommended that BSEE require that maritime rules are strictly implemented by vessel owners/operators during OWF installation and maintenance practices.

Incidents over the years showed that the soil contamination risk has a high probability of occurrence for ONWFs. Such incidents are caused by oil leak from nacelle or from installation and transportation vessels during construction and maintenance practices or from maintenance vehicles, oil storage tanks/containers at ONWF construction and maintenance facilities. Oil spill offshore can be prevented by implementing proper maintenance practices.

1.5.Event/Accident incident

In sections 3.1 through 3.3, event and accident incidents are covered. These are unscheduled activities which fall outside the normal schedule of OWF oversight.

It is recommended that BSEE require a robust accident reporting system that documents accidents and near-miss events within offshore and onshore wind sector, as there is a genuine need for accident records to be collected, monitored and assessed in the process of improving safety performance of the wind energy industry. At minimum the data on following incidents that should be collected:

a. Fatal accident
b. Serious injury caused by accidents such as fall from heights, electrocution, transportation, installation, boat landing
c. Vessel collision
d. Helicopter crash
e. Diving accidents
f. Near-miss event including near vessel collision, helicopter misses
g. Evacuation of personnel in response to non-weather-related events
h. Release of hazardous chemicals to soil and ocean
i. Electrical failure incidents or lightning incidents resulting in fire

[5] Ruth Stevenson, BSc, MSc, PhD, Environmental Impact Assessment for Wind Farms, 2006, UK http://gse.cat.org.uk/downloads/Environmental_Impact_Assessment_Consenting_Process_Windfarms.pdf

j. Incidents involving ice throw, rotor blade throw, structural failure resulting in collapse of WTG.

It is recommended that BSEE assign HSE auditors to audit OWF and ONWF owners and operators periodically to monitor the accident reporting and near-miss event tracking practices.

1.6. Inspections Personnel

1.6.1. Inspector Training and/or Certification

It is recommended that BSEE require inspectors who need to work in a wind turbine to have at least the following training before carrying out any inspections at wind farms:

a. Wind Turbine Climber Training

b. Confined Space Training

c. Ladder Safety Training

d. PPE Inspection Training

e. Onshore Basic Safety Training

f. Offshore Basic Safety Training (for OWFs)

g. Basic Offshore Safety Induction and Emergency Training (for OWFs)

h. Offshore First Aid Training

i. Risk Assessment Training

These are the same training requirements suggested for workers in OWF as stated earlier. This training portfolio should apply whether it is direct BSEE inspector or a third party inspector.

1.6.2. Responsible parties

In section 4, the subject of whom should carry on the inspections is covered in more detail. There are issues any of the options, and they vary with which phase the project is in. To summarize the recommendations though, for owner/operator inspections are practical for routine O&M phase with a flexible audit process administered either by BSEE and/or a third party. The timing of the audit frequency would have to be determined, but with a repeat period of 5-7 years would be prudent.

Reliance on owner/operator inspection reports would only be prudent if BSEE where to stipulate and communicate the punitive measures beforehand. Also, a clear and easy reporting format or digital reporting format would be recommended to facilitate the process by all sides.

Outside of the O&M phases, the design, installation and commissioning phases are mandated to have a CVA witnessing and certifying all critical functions. This includes insuring that the primary criteria which is under BSEE's scope is also checked. It is recommended that BSEE work with the CVA as their eyes and ears on the project. It is further recommended that having a clear inspection format and process which allows the materials of interest to be recorded, reported and transferred to BSEE.

For the event/accident, repowering, life extension and decommissioning phases, it is important that the processes and activities have a higher level of scrutiny and oversight. It is recommended that BSEE either have third party inspectors, or work closely with a third party with has field experience in these areas. This is due partly because of the novel nature of the event in general, and the unique challenges which each event will likely present.

1.7.Inspection Process and Reporting

1.7.1. Inspection needs

Before an inspection even occurs, there should be certain materials available and tasks complete.

- Contact information of OWF representative
- Orientation to the WT and OWF
- Resolve PPE incompatibility issues
- Access to WT and OWF history
- Equipment check, including spare batteries for recording devices
- Relevant tools, measuring instruments and recording equipment
- Adequate ship to turbine radio communication and frequencies

1.7.2. Inspection Report Content

The inspection report would likely be tailored to the particular phase that the project is undergoing. A one size fits all report would likely not benefit anyone. There should also be clear instructions available to the inspector about how to inspect and record their finding. Generally, there will not be easy to revisit the OWF to catch a mistake or lapse in the inspection process.

- Generic Inspection Report Instructions
- Inspector ID and associated training and certifications
- Time and location of the inspection
- Additional personnel on site
- Photo and video file storage methods
- Specific Inspection instructions of what to inspect for (trip specific)

(Ref section 3.13)

1.7.3. Data Format

It is recommended that BSEE utilize a digital device such as a smart tablet to log the report. Such a device should have a set form and format to record observations, pictures, etc. Input to the form could also be time stamped. I rugged identification application, such as a fingerprint check would also be recommended. All these functions will ensure the veracity and trustworthiness of the data in the report at the outset for efficient and accurate data capture with no loss in translation or transcription. This would enforce the uniformity, efficiency, accuracy and speed of data logging and analysis.

1.7.4. Data sharing/Analytic Reporting

BSEE is in a unique position in the industry to be mandated to collect data from all the various offshore wind installations. And they are mandated to use this data to improve health and safety as well as lessen the environmental impact. BSEE could take it a step further and work with either another government organization or a third party to take the data stream and perform deeper analysis. This analysis could be tasked more for reliability or other issues which will serve the industry as a whole. If this path is selected, any proprietary or identifying data should be scrubbed from the data. It is recommended that BSEE consider the option of using an outside body to do further analysis on the data they collect. Refer to section 3.17 for further detail on this subject.

In addition, as stated in section 3.1, there is not a single body which collects and publishes accident data for the wind industry. While it is outside the scope to handle this on a global scale, they could collect and publish these statistics for the US market. This would help the industry as a whole to evolve their HSE activities.

2. Examination of Regulation and Standards (Task 1)

This section examine all relevant state, national and international regulations and standards associated with OWF/ONWF and wind turbine inspections/audits/evaluations. These regulations and standards address all components of offshore wind energy generation over which BSEE may have inspection authority, including WTGs, substructures, foundations, transmission cables, offshore and onshore substations, and relevant onshore facilities. ABSG has reviewed all significant reports, standards, academic publications, and other literature relating to OWF and ONWF inspection, audit, or certification programs in this examination process. In this study, ABSG also performed a gap analysis in order to identify systems or regulations BSEE would need to implement to achieve similar regulatory oversight in the U.S.

In Europe, statutory inspection requirements vary between countries. While there are a number of statutory inspection requirements in Germany and Denmark, fewer such requirements exist in the rest of continental Europe and the UK.

2.1. UK Regulatory Requirements for Inspections, Audits & Evaluations

This section addresses what the regulations of domestic and international regulators say about offshore and onshore wind inspections or audits or evaluations in the UK.

In the UK, the majority of Health and Safety Executive (HSE) practices are regulated under the Health and Safety at Work Act 1974; the Health and Safety Commission and the Health and Safety Executive were also established under this Act. The Health and Safety at Work Act and regulations made under it impose on employers in the gas and electricity supply industries (as elsewhere) comprehensive duties designed to secure the health and safety of their employees and all other persons who may be affected by their work activities, including the general public. In 2013, the Health and Safety at Work Act 1974 (Application outside Great Britain) Order prescribed provisions of the 1974 Act to apply within the territorial sea, a designated area or a gas importation and storage zone to and in relation to all offshore activities including installation and operation of OWFs, OSP and subsea cables. In the UK, however, the statutory inspections are subject to other regulations.

In the UK, statutory inspections for the offshore and onshore wind turbines are required for the equipment listed below under the Lifting Operations and Lifting Equipment Regulations 1998 (LOLER),[6] the Pressure Systems Safety Regulations 2000 (PSSR),[7] The Provision and Use of Work Equipment Regulations 1998 (PUWER),[8] The Work at Height Regulations 2005[9] and The Health and Safety at Work Act 1974[10]:

a. Hydraulic Accumulators
b. Lifting Equipment
    i. Passenger/Service Lifts
    ii. Lifting Points/Beams
    iii. Electric Hoist Block/Tool hoist
    iv. Manual/Hydraulic Jib Crane
    v. Manual Chain Block
    vi. Safety Harness Anchorage Points
c. Fire Extinguishers/Fire Safety Equipment
d. Ladders/Runway track
e. Personal Protective Equipment (PPE)
    i. Escape/Rescue Equipment
    ii. Fall Arrest System
f. First Aid Equipment

In the UK, PUWER require risks to people's health and safety, from equipment that they use at work, to be prevented or controlled. In addition to the requirements of PUWER, lifting equipment is also subject to the requirements of LOLER. The Health and Safety at Work Act 1974 Regulation 65.(2).(b) demands, *"the inspection and maintenance of any services, fittings or equipment so provided"*; and (c) demands, *"the making of reports to any prescribed authority on the condition of any services, fittings or equipment so provided."*

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[6] Lifting Operations and Lifting Equipment Regulations 1998 (LOLER), UK, http://www.legislation.gov.uk/uksi/1998/2307/contents/made

[7] The Pressure Systems Safety Regulations (PSSR) 2000, UK, http://www.legislation.gov.uk/uksi/2000/128/pdfs/uksi_20000128_en.pdf

[8] The Provision and Use of Work Equipment Regulations (PUWER) 1998, UK http://www.legislation.gov.uk/uksi/1998/2306/contents/made

[9] The Work at Height Regulations 2005, UK, http://www.legislation.gov.uk/uksi/2005/735/contents/made

[10] The Health and Safety at Work etc. Act 1974, http://www.legislation.gov.uk/ukpga/1974/37/contents

2.1.1. Lifting Equipment and Hydraulic Accumulators

2.1.1.1. Lifting Equipment

Under the LOLER regulations in the UK, semiannual inspections are required for lifting accessories and equipment used to lift people, and annual inspections are required for all other lifting equipment. The UK HSE requires those inspections to be carried out by accredited third party inspection companies.

Also in the UK, Merchant Shipping (Code of Safe Working Practices for Merchant Seamen) Regulations 1998[11] Chapter 21.6 calls for thorough examination and inspections:

21.6.1 Where the safety of lifting equipment depends on the installation conditions, it should be inspected by a competent person before it is used for the first time. Such inspections should be undertaken on initial installation or after re-assembly at another location, to ensure that it has been installed correctly, in accordance with any manufacturer's instructions, and is safe for workers to operate as well as being able to function safely.

21.6.2 Any lifting equipment or accessory for lifting which is, or has been, exposed to conditions which could cause deterioration in its condition should be:

a. thoroughly examined
    i. in the case of lifting equipment for lifting persons or an accessory for lifting, at least every 6 months;
    ii. in the case of other lifting equipment, at least every 12 months; or
    iii. in either case, in accordance with an examination scheme; and
    iv. whenever exceptional circumstances which are liable to jeopardize the safety of the lifting equipment have occurred; and
b. where appropriate, inspected by a competent person at suitable intervals.

21.6.3 No accessories for lifting, other than those which are subject to paragraph 21.6.2(a), should be used unless they have been thoroughly examined within the 12 months immediately prior to such use.

In the UK, Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2006, also demands inspections to be carried out for the lifting equipment used in vessels. Regulation 12 Thorough Examination and Inspection[12] sets out the following requirements:

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[11] The Merchant Shipping (Code of Safe Working Practices for Merchant Seamen) Regulations 1998, page 280, Maritime and Coastguard Agency, the Department for Transport UK, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/282659/coswp2010.pdf

[12] The Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2006, page 19, Maritime and Coastguard Agency, the Department for Transport, UK,

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/282220/mgn332a.pdf

(1) The employer shall ensure that, where the safety of lifting equipment depends on the installation conditions, it is inspected by a competent person:

(a) after installation and before being put into service for the first time; or
(b) after assembly at a new site or in a new location, to ensure that it has been installed correctly, in accordance with any manufacturer's instructions, and is both safe to operate and capable of operating safely.

(2) Subject to paragraph (7), the employer shall ensure that where lifting equipment or an accessory for lifting is exposed to conditions causing deterioration which is liable to result in dangerous situations, it is:

(a) thoroughly examined
    (i) in the case of lifting equipment for lifting persons or an accessory for lifting, at least every 6 months;
    (ii) in the case of other lifting equipment, at least every 12 months; or
    (iii) in either case, in accordance with an examination scheme; and
    (iv) whenever exceptional circumstances which are liable to jeopardize the safety of the lifting equipment have occurred; and
(b) if appropriate, inspected by a competent person at suitable intervals, to ensure that health and safety conditions are maintained and that any deterioration can be detected and remedied in good time.

(3) In paragraph (2)(a)(iii), "examination scheme" means a suitable scheme drawn up by a competent person for such thorough examinations of lifting equipment at such intervals as may be appropriate for the purposes described in paragraphs (1) and (2).

(4) In paragraph (2)(a)(iv), "exceptional circumstances" shall include modification work, accidents, natural phenomena and prolonged periods of inactivity.

(5) The employer shall ensure that no lifting equipment:

(a) is used outside the ship; or
(b) if obtained from outside the ship, is used on the ship, unless it is accompanied by physical evidence that the last thorough examination required to be carried out under this regulation has been carried out.

(6) The employer shall not permit the use of any accessories for lifting, other than those which are subject to paragraph (2)(a), unless they have been thoroughly examined within the 12 months immediately prior to such use.

(7) Where lifting equipment was before the coming into force of these Regulations thoroughly examined or required to be so examined in accordance with regulation 8 of the Merchant Shipping (Hatches and Lifting Plant) Regulations 1988, the first thorough examination under paragraph (2) shall be made no

later than the date by which a thorough examination would have been required, or next required, by that regulation had it remained in force.

(8) In relation to an inspection under this regulation, “inspection”:

(a) means such visual or more rigorous inspection by a competent person as is appropriate for the purpose described;
(b) where it is appropriate to carry out testing for the purpose, includes testing the nature and extent of which are appropriate for the purpose.

(9) In paragraph (5) "used outside the ship" means both:

(a) used on the quayside, dock or jetty or on board another ship; and
(b) operated by workers who are employed by another person.

Regulations 14 and 15 of the Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2006, UK[13] make the following demands for reporting the inspection results:

(14) (4) A person making an inspection for an employer under paragraph (1) or (2)(b) of regulation 12 shall:

(a) notify the employer, or other person who has control of the matter, forthwith of any deficiency in the lifting equipment which in his opinion is or could become a danger to persons;
(b) as soon as is practicable make a record of the inspection in writing.

(15)(2) Notwithstanding the requirements of paragraph (1) the employer shall ensure that the information contained in:

(a) every report made under regulation 14(2) or record made under regulation 14(4) is kept available for inspection until the next such report is made
(b) every report made to him under regulation 14(2) is kept available for inspection:
    (i) in the case of a thorough examination of lifting equipment until he ceases to use the lifting equipment;
    (ii) in the case of a thorough examination of an accessory for lifting under regulation 12(6), for two years after the report is made;
    (iii) in the case of a thorough examination under regulation 12(2), for two years after receipt of that report, or until the next report is made under that regulation, whichever is later;

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[13] The Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2006, pages 22, 24, Maritime and Coastguard Agency, the Department for Transport, UK

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/282220/mgn332a.pdf

(c) every record made in respect of an inspection carried out under regulation 12(1) is kept available for inspection until he ceases to use the lifting equipment at the place it was installed or assembled.

Under the Duties Section[14] of the Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2006, it is required that, "*The Offshore Installation Manager should be satisfied with the inspection and testing of the personnel basket*," and that all Cranes and Personnel Baskets meet the requirements outlined below:

All personnel baskets must possess a current thorough examination report undertaken by a competent person in accordance with the UK LOLER Regulation 9.

(a) The safe working load (SWL) should be clearly marked on all personnel baskets, together with instructions for their use.
(b) Procedures should include the methods of maintenance and storage together with instructions related to inspection before use.
(c) 'Freefall' or non-powered lowering should not be adopted when personnel are carried in baskets.

2.1.1.2. Hydraulic Accumulators

Like the lifting inspections, the inspections of hydraulic accumulators of WTGs must be carried out by a third party in accordance with the written scheme of examination, which must be prepared by a competent person. It is the user's responsibility under the PSSR to ensure the content of the written scheme is reviewed at appropriate intervals by a competent person to determine whether it remains suitable, but clearly the competent person should be in a position to give advice on this aspect. According to Part II, Clause 6 of the PSSR*, "The employer of a person who installs a pressure system at work shall ensure that nothing about the way in which it is installed gives rise to danger or otherwise impairs the operation of any protective device or inspection facility."* In case of modification, the Part II, Clause 13 states that, "*The employer of a person who modifies or repairs a pressure system at work shall ensure that nothing about the way in which it is modified or repaired gives rise to danger or otherwise impairs the operation of any protective device or inspection facility."* With regards to the written scheme of examination, the Part II, Clause 8 of PSSR states that:

1. The user of an installed system and owner of a mobile system shall not operate the system or allow it to be operated unless he has a written scheme for the periodic examination, by a competent person, of the following parts of the system, that is to say:

a. all protective devices;
b. every pressure vessel and every pipeline in which (in either case) a defect may give rise to danger; and

[14] The Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2006, page 33, Maritime and Coastguard Agency, the Department for Transport, UK

c. those parts of the pipework in which a defect may give rise to danger and such parts of the system shall be identified in the scheme.

2. The said user or owner shall:

a. ensure that the scheme has been drawn up, or certified as being suitable, by a competent person;
b. ensure that:
   i. the content of the scheme is reviewed at appropriate intervals by a competent person for the purpose of determining whether it is suitable in current conditions of use of the system; and
   ii. the content of the scheme is modified in accordance with any recommendations made by that competent person arising out of that review.

3. No person shall draw up or certify a scheme of examination under paragraph (2)(a) unless the scheme is suitable and:

a. specifies the nature and frequency of examination;
b. specifies any measures necessary to prepare the pressure system for safe examination other than those it would be reasonable to expect the user (in the case of an installed system) or owner (in the case of a mobile system) to take without specialist advice; and
c. where appropriate, provides for an examination to be carried out before the pressure system is used for the first time.

4. References in paragraphs (2) and (3) to the suitability of the scheme are references to its suitability for the purposes of preventing danger from those parts of the pressure system included in the scheme.

Examination process for hydraulic accumulators of WTGs in accordance with the written scheme is elaborated in the Part II, Clause 9 of PSSR:

1. Subject to paragraph (7), the user of an installed system and the owner of a mobile system shall:

a. ensure that those parts of the pressure system included in the scheme of examination are examined by a competent person within the intervals specified in the scheme and, where the scheme so provides, before the system is used for the first time; and
b. before each examination take all appropriate safety measures to prepare the system for examination, including any such measures as are specified in the scheme of examination pursuant to regulation 8(3)(b).

2. Where a competent person undertakes an examination for the purposes of paragraph (1) he shall carry out that examination properly and in accordance with the scheme of examination.

3. Where a competent person has carried out an examination for the purposes of paragraph (1) he shall, subject to paragraph (4) and regulation 14(4), make a written report of the examination, sign it or add his name to it, date it and send it to the user (in the case of an installed system) or owner (in the case of

a mobile system); and the said report shall be so sent as soon as is practicable after completing the examination (or, in the case of integrated installed systems where the examination is part of a series, as soon as is practicable after completing the last examination in that series), and in any event to arrive:

a. within 28 days of the completion of the examination (or, in the case of integrated installed systems where the examination is part of a series, within 28 days of the completion of the last examination in that series); or
b. before the date specified in the report under paragraph (5)(b), whichever is sooner.

4. Where the competent person referred to in paragraph (3) is the user (in the case of an installed system) or owner (in the case of a mobile system) the requirement in that paragraph to send the report to the user or owner shall not apply, but he shall make the report by the time it would have been required to have been sent to him under that paragraph if he had not been the competent person.

(5) The report required by paragraph (3) shall:

a. state which parts of the pressure system have been examined, the condition of those parts and the results of the examination;
b. specify any repairs or modifications to, or changes in the established safe operating limits of, the parts examined which, in the opinion of the competent person, are necessary to prevent danger or to ensure the continued effective working of the protective devices, and specify the date by which any such repairs or modifications must be completed or any such changes to the safe operating limits must be made;
c. specify the date within the limits set by the scheme of examination after which the pressure system may not be operated without a further examination under the scheme of examination; and
d. state whether in the opinion of the competent person the scheme of examination is suitable (for the purpose of preventing danger from those parts of the pressure system included in it) or should be modified and if the latter, state the reasons.

6. The user of an installed system and the owner of a mobile system which has been examined under this regulation shall ensure that the system is not operated, and no person shall supply such a mobile system for operation, after (in each case):

a. the date specified under paragraph (5)(b), unless the repairs or modifications specified under that paragraph have been completed, and the changes in the established safe operating limits so specified have been made; or
b. the date specified under paragraph (5)(c) (or, if that date has been postponed under paragraph (7), the postponed date) unless a further examination has been carried out under the scheme of examination.

7. The date specified in a report under paragraph (5)(c) may be postponed to a later date by agreement in writing between the competent person who made the report and the user (in the case of an installed system) or owner (in the case of a mobile system) if:

a. such postponement does not give rise to danger;
b. only one such postponement is made for any one examination; and
c. such postponement is notified by the user or owner in writing to the enforcing authority for the premises at which the pressure system is situated, before the date specified in the report under paragraph (5)(c).

8. Where the competent person referred to in paragraph (7) is the user (in the case of an installed system) or owner (in the case of a mobile system) the reference in that paragraph to an agreement in writing shall not apply, but there shall be included in the notification under subparagraph (c) of that paragraph a declaration that the postponement will not give rise to danger.

9. The owner of a mobile system shall ensure that the date specified under paragraph (5)(c) is legibly and durably marked on the mobile system and that the mark is clearly visible.

In summary, the PSSR 2000, require users and owners of hydraulic accumulators to demonstrate knowledge in the safe operating limits of pressure and temperature, demonstrate the systems are safe under those conditions, ensure a suitable written scheme of examination is in place before the system is operated and ensure the pressure system is actually examined in accordance with the written scheme of examination. There are no compulsory inspection intervals in the UK; instead, a 48 to 60 month inspection interval is recommended for gas-loaded hydraulic accumulators, but the actual frequency of hydraulic accumulators inspections will vary in accordance with individual wind farms and maintenance regimes.

2.1.2. Fire Extinguisher

British Standard (BS) EN 3-7:2004+A1:2007 Portable Fire Extinguishers ADR 8.1.4.4, para. 3[15] stipulate that the fire extinguishers must be periodically inspected in accordance with BS EN:3 1996 Portable Fire Extinguishers Standard in order to guarantee their functional safety in the UK. This rule applies to all portable fire extinguishers, which are stationed in OWF and ONWFs in the UK.

2.1.3. Personal Protective Equipment

It is vital to ensure the PPE is maintained properly to prevent malfunction of any PPE during the installation and maintenance of OWF and ONWF components.

The UK, PUWER, Part II, Regulation 12, Protection against Specified Hazards[16] demands that:

(1) Every employer shall take measures to ensure that the exposure of a person using work equipment to any risk to his health or safety from any hazard specified in paragraph (3) is either prevented, or, where that is not reasonably practicable, adequately controlled.

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[15] BS EN 3-7:2004+A1:2007 Portable Fire Extinguishers, BSI, 2007, UK

[16] Provision and Use of Work Equipment Regulations (PUWER) 1998, UK
http://www.legislation.gov.uk/uksi/1998/2306/regulation/12/made

(2) The measures required by paragraph (1) shall:

*a. be **measures** other than the provision of personal protective equipment or of information, instruction, training and supervision, so far as is reasonably practicable; and*

*b. include, where appropriate, **measures** to minimize the effects of the hazard as well as to reduce the likelihood of the hazard occurring.*

(3) The hazards referred to in paragraph (1) are:

a. any article or substance falling or being ejected from work equipment;

b. rupture or disintegration of parts of work equipment;

c. work equipment catching fire or overheating;

d. the unintended or premature discharge of any article or of any gas, dust, liquid, vapor or other substance which, in each case, is produced, used or stored in the work equipment;

e. the unintended or premature explosion of the work equipment or any article or substance produced, used or stored in it.

(4) For the purposes of this regulation "adequately" means adequately having regard only to the nature of the hazard and the nature and degree of exposure to the risk

The UK, PUWER, Part IV, Regulation 33, Inspection of Guards and Protection Devices[17] stipulates that:

(1) Every employer shall ensure that a power press is not used after the setting, re-setting or adjustment of its tools, save in trying out its tools or save in die proving, unless:

a. its every guard and protection device has been inspected and tested while in position on the power press by a person appointed in writing by the employer who is:

i. competent; or

ii. undergoing training for that purpose and acting under the immediate supervision of a competent person, and who has signed a certificate which complies with paragraph (3); or

b. the guards and protection devices have not been altered or disturbed in the course of the adjustment of its tools.

(2) Every employer shall ensure that a power press is not used after the expiration of the fourth hour of a working period unless its every guard and protection device has been inspected and

[17] The Provision and Use of Work Equipment Regulations (PUWER) 1998, UK

http://www.legislation.gov.uk/uksi/1998/2306/regulation/33/made

tested while in position on the power press by a person appointed in writing by the employer who is:

a. *competent; or*

b. *undergoing training for that purpose and acting under the immediate supervision of a competent person, and who has signed a certificate which complies with paragraph (3).*

(3) A certificate referred to in this regulation shall:

a. *contain sufficient particulars to identify every guard and protection device* ***inspected*** *and tested and the power press on which it was positioned at the time of the inspection and test;*

b. *state the date and time of the inspection and test; and*

c. *state that every guard and protection device on the power press is in position and effective for its purpose.*

2.1.4. Work Equipment

The UK, PUWER, Part II, Regulation 6, Inspection stipulates that:

(1) Every employer shall ensure that, where the safety of work equipment depends on the installation conditions, it is ***inspected****:*

a. *after installation and before being put into service for the first time; or*

b. *after assembly at a new site or in a new location, to ensure that it has been installed correctly and is safe to operate.*

(2) Every employer shall ensure that work equipment exposed to conditions causing deterioration which is liable to result in dangerous situations is ***inspected****:*

a. *at suitable intervals; and*

b. *each time that exceptional circumstances which are liable to jeopardize the safety of the work equipment have occurred, to ensure that health and safety conditions are maintained and that any deterioration can be detected and remedied in good time.*

(3) Every employer shall ensure that the result of an inspection made under this regulation is recorded and kept until the next inspection under this regulation is recorded.

(4) Every employer shall ensure that no work equipment:

a. *leaves his undertaking; or*

b. *if obtained from the undertaking of another person, is used in his undertaking, unless it is accompanied by physical evidence that the last inspection required to be carried out under this regulation has been carried out.*

The UK, PUWER, Regulation 5 Maintenance[18] requires all work equipment to be maintained properly and leave the responsibility of the maintenance with employers:

(1) Every employer shall ensure that work equipment is maintained in an efficient state, in efficient working order and in good repair.

(2) Every employer shall ensure that where any machinery has a maintenance log, the log is kept up to date.

In the UK, Merchant Shipping and Fishing Vessels (Provision and Use of Work Equipment) Regulations 2006, Chapter 3[19] Inspection of Work Equipment demands regular inspections to be carried out. The regulation makes the following demands:

3.1 Where the safety of work equipment depends on the manner in which it was installed it should be inspected by a competent person after installation and before being brought into use and at regular intervals thereafter.

3.2 It is strongly recommended that the maximum interval between inspections should be 5 years for work equipment, or such shorter period as is recommended by the manufacturer. Further guidance on inspections should be aligned with equipment manufacturers' recommendations.

3.3 A “competent person” should carry out all inspections.

Chapter 9 Records of Equipment of the same regulations also requires, *“9.1 In service inspections are to be carried out in accordance with these Regulations.”* Chapter 10 Survey and Inspection by Maritime Coastguard Agency (MCA) Surveyors also states that, *“10.1 Work Equipment is subject to safety inspection by MCA surveyors at any time.”*

The Merchant Shipping and Fishing Vessels (Provision and Use of Work Equipment) Regulations 2006 also demands further inspections to be carried out on the vessels operating in the UK territorial waters. They are listed within the Regulation 8[20] below:

(1) The employer shall ensure that, where the safety of work equipment depends on the installation conditions, it is inspected by a competent person:

a. after installation and before being put into service for the first time; or

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[18] The Provision and Use of Work Equipment Regulations 1998, UK, http://www.legislation.gov.uk/uksi/1998/2306/regulation/5/made

[19] Merchant Shipping and Fishing Vessels (Provision and Use of Work Equipment) Regulations 2006, page 2, Maritime and Coastguard Agency, the Department for Transport, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/282215/mgn331.pdf

[20] Merchant Shipping and Fishing Vessels (Provision and Use of Work Equipment) Regulations 2006, pages 11,12, Maritime and Coastguard Agency, the Department for Transport

b. after assembly at a new site or in a new location, to ensure that it has been installed correctly, in accordance with any manufacturer's instructions, and is both safe to operate and capable of operating safely.

(2) The employer shall ensure that work equipment exposed to conditions causing deterioration which is liable to result in dangerous situations is inspected by a competent person:

a. at suitable intervals; and
b. each time that exceptional circumstances which are liable to jeopardize the safety of work equipment have occurred, to ensure that health and safety conditions are maintained and that any deterioration can be detected and remedied in good time.

(3) In sub-paragraph (2)(b), "exceptional circumstances " shall include modification work, accidents, natural phenomena and prolonged periods of inactivity.

(4) The employer shall ensure that the result of an inspection made under this regulation is recorded, retained and readily available for inspection until the next inspection has been made and recorded.

(5) The employer shall ensure that no work equipment:

a. if obtained from on board the ship, is used outside the ship, or
b. if obtained from outside the ship, is used in the ship, unless it is accompanied by physical evidence that the last inspection required to be carried out under this regulation has been carried out.

(6) In paragraph (5) "used outside the ship" means both:

a. used anywhere outside the ship (including on board another ship); and
b. operated by workers who are employed by another person.

(7) This regulation does not apply to work equipment used for lifting loads, including persons.

(8) In relation to an inspection under this regulation, "inspection"—

a. means such visual or more rigorous inspection by a competent person as is appropriate for the purpose described;
b. where it is appropriate to carry out testing for the purpose, includes testing the nature and extent of which are appropriate for that purpose.

It is also stated in the guidance note on the Regulation 8 that:

1. Where the safety of work equipment depends on the installation conditions, it must be inspected by a competent person after installation and before being put into service for the first time, or after assembly at a new site or in a new location, to ensure that it has been installed correctly and is safe to use. Such inspections should cover factors such as the standard of welding or other fixing and materials used, and the strength of any part of the

ship to which it is attached and which supports it. It is also recommended that such work equipment is re-inspected at regular intervals, not exceeding 5 years or more frequently if so recommended in the manufacturer's inspection data, to ensure that no subsequent deterioration in its installation has occurred. Any work equipment exposed to conditions causing deterioration which is liable to result in dangerous situations must be inspected by a competent person at suitable intervals and any necessary remedial action taken to ensure its continuing safety.

2. The results of all inspections are to be recorded and all such records are to be retained, readily available for inspection, until such time as a further inspection has been undertaken and recorded.
3. Where any ship's work equipment is to be used outside the ship, or work equipment from outside the ship is obtained for use on the ship, it must be accompanied by physical evidence that the last inspection required to be carried out under these Regulations has actually been carried out. In this context "used outside the ship" means both used on the quayside, dock or jetty or on board another ship; and/or operated by workers who are employed by another person.
4. Any work equipment used for lifting loads, including personnel, comes under the Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2006, which set out specific requirements for the "inspection", "testing" and "thorough examination" of such lifting equipment.
5. In the context of this regulation "inspection" means the carrying out of such visual or more rigorous inspection by a competent person as will meet the specific requirements of this regulation. In addition, "inspection" may, where considered appropriate, include such testing, the nature and extent of which are to be determined by the employer and/or competent person, as is considered appropriate to meet the requirements of this regulation.

2.1.4.1. Inspections

In the UK, the Work at Height Regulations 2005 require the inspection of certain work equipment and of places of work at height (regulations 12 and 13 and Schedule 7). According to Regulation 12 Inspection of Work Equipment.[21]

(1) This regulation applies only to work equipment to which regulation 8 and Schedules 2 to 6 apply.[22]

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[21] The Work at Height Regulations 2005, page 7, HSE, UK

[22] Reg.8. Requirements for particular work equipment: Every employer shall ensure that, in the case of:

(a) a guard-rail, toe-board, barrier or similar collective means of protection, Schedule 2 is complied with;

(b) a working platform:

i. Part 1 of Schedule 3 is complied with; and

(2) Every employer shall ensure that, where the safety of work equipment depends on how it is installed or assembled, it is not used after installation or assembly in any position unless it has been inspected in that position.

*(3) Every employer shall ensure that work equipment exposed to conditions causing deterioration which is liable to result in dangerous situations is **inspected**:*

- *a. at suitable intervals; and*
- *b. each time that exceptional circumstances which are liable to jeopardize the safety of the work equipment have occurred, to ensure that health and safety conditions are maintained and that any deterioration can be detected and remedied in good time.*

(4) Without prejudice to paragraph (2), every employer shall ensure that a working platform:

- *a. used for construction work; and*
- *b. from which a person could fall 2 meters or more,*

is not used in any position unless it has been inspected in that position or, in the case of a mobile working platform, inspected on the site, within the previous 7 days.

(5) Every employer shall ensure that no work equipment, other than lifting equipment to which the requirement in regulation 9(4) of the LOLER applies:

- *a. leaves his undertaking; or*
- *b. if obtained from the undertaking of another person, is used in his undertaking, unless it is accompanied by physical evidence that the last **inspection** required to be carried out under this regulation has been carried out.*

*(6) Every employer shall ensure that the result of an **inspection** under this regulation is recorded and, subject to paragraph (8), kept until the next inspection under this regulation is recorded.*

*(7) A person carrying out an **inspection of work equipment** to which paragraph (4) applies shall:*

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ii. where scaffolding is provided, Part 2 of Schedule 3 is also complied with;

(c) a net, airbag or other collective safeguard for arresting falls which is not part of a personal fall protection system, Schedule 4 is complied with;

(d) a personal fall protection system, Part 1 of Schedule 5 and:

iii. in the case of a work positioning system, Part 2 of Schedule 5;

iv. in the case of rope access and positioning techniques, Part 3 of Schedule 5;

v. in the case of a fall arrest system, Part 4 of Schedule 5;

vi. in the case of a work restraint system, Part 5 of Schedule 5,

vii. are complied with; and

(e) a ladder, Schedule 6 is complied with.

a. *before the end of the working period within which the inspection is completed, prepare a report containing the particulars set out in Schedule 7; and*

b. *within 24 hours of completing the inspection, provide the report or a copy thereof to the person on whose behalf the inspection was carried out.*

(8) An employer receiving a report or copy under paragraph (7) shall keep the report or a copy thereof:

a. *at the site where the inspection was carried out until the construction work is completed; and*

b. *thereafter at an office of his for 3 months.*

(9) Where a thorough ***examination*** *has been made of* ***lifting equipment*** *under regulation 9 of LOLER:*

a. *it shall for the purposes of this regulation, other than paragraphs (7) and (8), be treated as an inspection of the lifting equipment; and*

b. *the making under regulation 10 of LOLER of a report of such examination shall for the purposes of paragraph (6) of this regulation be treated as the recording of the inspection.*

*(10) In this regulation "****inspection,****" subject to paragraph (9):*

a. *means such visual or more rigorous inspection by a competent person as is appropriate for safety purposes;*

b. *includes any testing appropriate for those purposes, and "inspected" shall be construed accordingly*.

This regulation demonstrates that the inspection responsibility is with the employer who is ultimately legally responsible for ensuring timely inspections of working equipment captured in Regulation 8 of the Work at Height Regulations 2005. Likewise, the employer is responsible for accurate recording and maintenance of the inspection records.

2.1.4.2. Inspection Reporting

The UK Work at Height Regulations 2005, Schedule 7, Regulation 12(7) defines particulars to be included in a report of inspection:

1. *The name and address of the person for whom the inspection was carried out.*
2. *The location of the work equipment inspected.*
3. *A description of the work equipment inspected.*
4. *The date and time of the inspection.*
5. *Details of any matter identified that could give rise to a risk to the health or safety of any person.*
6. *Details of any action taken as a result of any matter identified in paragraph 5.*

7. *Details of any further action considered necessary.*
8. *The name and position of the person making the report.*

2.1.5. Ladders and Fall Arrest System

The UK Work at Height Regulations 2005 stipulates places of work at height to be inspected. The regulation 13[23] states, "Every employer shall so far as is reasonably practicable ensure that the surface and every parapet, permanent rail or other such fall protection measure of every place of work at height are checked on each occasion before the place is used."

2.1.5.1. Ladders

The UK Work at Height Regulations 2005, Schedule 6, Regulation 8(c).(1) Requirements for Ladders states*:*

(1) Every employer shall ensure that a ladder is used for work at height only if a **risk assessment** under regulation 3 of the Management Regulations has demonstrated that the use of more suitable work equipment is not justified because of the low risk and:

a. the short duration of use; or
b. existing features on site which he cannot alter.

The UK Work at Height Regulations 2005, Schedule 6, Regulation 8(e).(10) Requirements for Ladders states:

(10) Every ladder shall be used in such a way that:

a. a secure handhold and secure support are always available to the user; and
b. the user can maintain a safe handhold when carrying a load unless, in the case of a step ladder, the maintenance of a handhold is not practicable when a load is carried, and a **risk assessment** under regulation 3 of the Management Regulations has demonstrated that the use of a stepladder is justified because of:
    i. the low risk; and
    ii. the short duration of use.

2.1.5.2. Fall Arrest System

The UK Work at Height Regulations 2005, Schedule 4, Regulation 8(c), Requirements for Collective Safeguards for Arresting Falls states that:

1. *Any reference in this Schedule to a safeguard is to a collective safeguard for arresting falls.*
2. *A safeguard shall be used only if:*

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[23] The Work at Height Regulations 2005, page 8, UK

a. *a **risk assessment** has demonstrated that the work activity can so far as is reasonably practicable be performed safely while using it and without affecting its effectiveness;*

b. *the use of other, safer work equipment is not reasonably practicable; and*

c. *a sufficient number of available persons have received adequate training specific to the safeguard, including rescue procedures.*

The UK Work at Height Regulations 2005, Schedule 5, Regulation 8(d), Requirements for Personal Fall Protection Systems states that:

1. A personal fall protection system shall be used only if:

a. a **risk assessment** has demonstrated that:
    i. the work can so far as is reasonably practicable be performed safely while using that system; and
    ii. the use of other, safer work equipment is not reasonably practicable; and

b. the user and a sufficient number of available persons have received adequate training specific to the operations envisaged, including rescue procedures.

2. A personal fall protection system shall:

a. be suitable and of sufficient strength for the purposes for which it is being used having regard to the work being carried out and any foreseeable loading;
b. where necessary, fit the user;
c. be correctly fitted;
d. be designed to minimize injury to the user and, where necessary, be adjusted to prevent the user falling or slipping from it, should a fall occur; and
e. be so designed, installed and used as to prevent unplanned or uncontrolled movement of the user.

3. A personal fall protection system designed for use with an anchor shall be securely attached to at least one anchor, and each anchor and the means of attachment thereto shall be suitable and of sufficient strength and stability for the purpose of supporting any foreseeable loading.

4. Suitable and sufficient steps shall be taken to prevent any person falling or slipping from a personal fall protection system.

2.1.6. Work Platforms

The blade inspection carried out using the rope access or work platforms such as man-baskets/ cherry pickers are also subject to certain inspection requirements.

The UK, Construction (Health, Safety and Welfare) Regulations 1996, Schedule 7 Places of Work Requiring Inspection[24] stipulates that **inspection** is required for a*ny working platform or part thereof or any personal suspension equipment provided pursuant to paragraph (3)(b) or (c) of regulation 6 (Falls)*[25]*:*

i. 1. Before being taken into use for the first time; and

ii. after any substantial addition, dismantling or other alteration; and

iii. after any event likely to have affected its strength or stability; and

iv. at regular intervals not exceeding 7 days since the last inspection.

The majority of the accidents resulting in major injuries or fatalities in OWF and ONWFs in Europe are caused by falls. Therefore it is vital that the working platforms are safe to use during the installation or maintenance activities at wind farms. Because of the major safety issues experienced in this area, the legal requirements for safe practices are discussed.

The UK Work at Height Regulations 2005, Schedule 3 Regulation 8(b), Requirements for Working Platforms Part 1; Requirements for all Working Platforms[26] states the following:

1. In this Schedule, "supporting structure" means any structure used for the purpose of supporting a working platform and includes any plant used for that purpose.

2. Condition of surfaces: Any surface upon which any supporting structure rests shall be stable, of sufficient strength and of suitable composition safely to support the supporting structure, the working platform and any loading intended to be placed on the working platform.

3. Stability of supporting structure: Any supporting structure shall:

a. be suitable and of sufficient strength and rigidity for the purpose for which it is being used;

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[24] Construction (Health, Safety and Welfare) Regulations 1996, UK http://www.legislation.gov.uk/uksi/1996/1592/schedule/7/made

[25] 6. (1) Suitable and sufficient steps shall be taken to prevent, so far as is reasonably practicable, any person falling.

(3) Without prejudice to the generality of paragraph (1) and subject to paragraph (6), where any person is to carry out work at a place from which he is liable to fall a distance of 2 metres or more or where any person is to use a means of access to or egress from a place of work from which access or egress he is liable to fall a distance of 2 meters or more:

(b)where it is necessary in the interest of the safety of any person that a working platform be provided, there shall, subject to sub-paragraphs (c) and (d) below, be so provided and used a sufficient number of working platforms which shall comply with the provisions of Schedule 2; and .

(c) where it is not practicable to comply with all or any of the requirements of sub-paragraphs (a) or (b) above or where due to the nature or the short duration of the work compliance with such requirements is not reasonably practicable, there shall, subject to sub-paragraph (d) below, be provided and used suitable personal suspension equipment which shall comply with the provisions of Schedule 3

[26] The Work at Height Regulations, UK, http://www.legislation.gov.uk/uksi/2005/735/schedule/3/made

b. in the case of a wheeled structure, be prevented by appropriate devices from moving inadvertently during work at height;

c. in other cases, be prevented from slipping by secure attachment to the bearing surface or to another structure, provision of an effective anti-slip device or by other means of equivalent effectiveness;

d. be stable while being erected, used and dismantled; and

e. when altered or modified, be so altered or modified as to ensure that it remains stable.

4. Stability of working platforms: A working platform shall:

a. be suitable and of sufficient strength and rigidity for the purpose or purposes for which it is intended to be used or is being used;

b. be so erected and used as to ensure that its components do not become accidentally displaced so as to endanger any person;

c. when altered or modified, be so altered or modified as to ensure that it remains stable; and

d. be dismantled in such a way as to prevent accidental displacement.

5. Safety on working platforms: A working platform shall:

a. be of sufficient dimensions to permit the safe passage of persons and the safe use of any plant or materials required to be used and to provide a safe working area having regard to the work being carried out there;

b. possess a suitable surface and, in particular, be so constructed that the surface of the working platform has no gap—

i. through which a person could fall;

ii. through which any material or object could fall and injure a person; or

iii. giving rise to other risk of injury to any person, unless measures have been taken to protect persons against such risk; and

c. be so erected and used, and maintained in such condition, as to prevent, so far as is reasonably practicable—

i. the risk of slipping or tripping; or

ii. any person being caught between the working platform and any adjacent structure.

6. A working platform and any supporting structure shall not be loaded so as to give rise to a risk of collapse or to any deformation which could affect its safe use.

In the UK, the work platforms must be checked, **inspected** or examined under the Construction (Health, Safety and Welfare) Regulations 1996, the LOLER and the Work at Height Regulations 2005. Table 1[27] below shows the timing and frequency of checks, inspections and examinations.

	Timing and Frequency of Checks, Inspections and Examinations (UK)								
Place of Work or Work Equipment	Inspect before work at the start of every shift (see note 1)	Inspect after any event likely to have affected its strength or stability	Inspect after accidental fall of rock, earth or other material	Inspect after installation or assembly in any position (see notes 2 and 3)	Inspect at suitable intervals	Inspect after exceptional circumstances which are liable to jeopardise the safety of work equipment	Inspect at intervals not exceeding 7 days (see note 3)	Check on each occasion before use (REPORT NOT REQUIRED)	LOLER Thorough Examination (if work equipment subject to LOLER) (see note 4)
Excavations which are supported to prevent any person being buried or trapped by an accidental collapse or a fall or dislodgement of material	✓	✓	✓						
Cofferdams and caissons	✓	✓							
The surface and every parapet or permanent rail of every existing place of work at height								✓	
Guard rails, toe boards, barriers and similar collective means of fall protection				✓	✓	✓			
Scaffolds and other working platforms (including tower scaffolds and MEWPs) used for construction work and from which a person could fall more than 2m				✓		✓	✓		✓
All other working platforms				✓	✓	✓			✓
Collective safeguards for arresting falls (eg nets, airbags, soft landing systems)				✓	✓	✓			
Personal fall protection systems (including work positioning, rope access, work restraint and fall arrest systems)				✓	✓	✓			✓
Ladders and stepladders					✓	✓		✓	

[27] Inspection and Report, UK Health and Safety Executive, http://www.hse.gov.uk/pubns/cis47.pdf

Notes:

a. Although an excavation must be inspected at the start of every shift, only one report is needed in any seven-day period. However, if something happens to affect its strength or stability, and/or an additional inspection is carried out, a report must then be completed. A record of this inspection must be processed.
b. “Installation” means putting into position and “assembly” means putting together. You are not required to inspect and provide a report every time a ladder, tower scaffold or mobile elevated work platform (MEWP) is moved on site or a personal fall protection system is clipped to a new location.
c. An inspection and a report is required for a tower scaffold or MEWP (used for construction work and from which a person could fall 2 meters) after installation or assembly and every seven days thereafter, providing the equipment is being used on the same site. A record of this inspection must be processed as outlined on page 1. If a tower scaffold is reassembled rather than simply moved, then an additional, pre-use inspection and report is required. It is acceptable for this inspection to be carried out by the person responsible for erecting the tower scaffold, providing they are trained and competent. A visible tag system, which supplements inspection records as it is updated following each pre-use inspection, is a way of recording and keeping the results until the next inspection.
d. All work equipment subject to LOLER regulation 9, thorough examination and inspection requirements, will continue to be subject to LOLER regulation 9 requirements.

2.1.7. Confined Space

A confined space is any space with difficult access and exit and restricted natural ventilation. In addition to many other physical and mechanical risks, toxic or flammable pollutants may accumulate in such spaces and they may be deprived of oxygen. These spaces are not suitable for the worker’s continued presence[28].

Inside the rotor blade and the area below the airtight deck of offshore wind turbine foundation are classified as confined space. As the confined space can be deadly, some countries addressed this safety issue by introducing regulations in order to mitigate the safety risks inherent in activities carried out in a confined space.

In the UK, Confined Space Regulations were introduced in 1997. With this law, it became compulsory to have the confined space training for anyone (inspector or engineer) who enters confined space, works/supervise works/inspects works in a confined space. UK Confined Space Regulations 1997,

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[28] Working in Confined Spaces-Best Practice Guide-Blades, Asociacion Empresarial Eolica (The Spanish Wind Energy Association), 2012, Spain http://www.aeeolica.org/uploads/documents/4160-working-in-confined-spaces-best-practice-guide-blades.pdf

Reg.5.(1)[29] stipulates, "*Without prejudice to regulation 4 of these Regulations, no person at work shall enter or carry out work in a confined space unless there have been prepared in respect of that confined space suitable and sufficient arrangements for the rescue of persons in the event of an emergency, whether or not arising out of a specified risk*."

People are killed or seriously injured in confined spaces every year. This includes a large number of people trying to rescue others without sufficient equipment or training. In line with the UK regulations, it is recommended the following hierarchy of controls to be carried out prior to commencing inspections below the airtight deck of an offshore WTG foundation or in a rotor blade of a WTG:

a. Assess whether inspection can be done in another way to avoid entry into confined space
b. If entry to a confined space is unavoidable, follow a safe system of work
c. Put in place adequate emergency arrangements before the work starts
d. The main danger is untested atmosphere which may be oxygen deficient or contain atmospheric contaminants; if that is the case ventilate the confined space by opening the hatch in advance of inspections and use respiratory protective equipment

In the UK, Merchant Shipping (Code of Safe Working Practices for Merchant Seamen) Regulations 1998,[30] also regulates the maintenance of equipment for entry into dangerous spaces and stipulates periodic inspections: *"17.13.9 All breathing apparatus, rescue harnesses, lifelines, resuscitation equipment and any other equipment provided for use in, or in connection with, entry into dangerous spaces, or for use in emergencies, should be properly maintained, inspected periodically and checked for correct operation by a competent person and a record of the inspections and checks should be kept. All items of breathing apparatus should be inspected for correct operation before and after use."*

2.1.8. Construction of Wind Farms

In the UK the Construction Design Management (CDM) Regulations impose certain duties relating to health and safety on offshore and onshore construction sites on the wind farm developer (it is referred to as "client" in the legislation). It is stated in the paragraph 17 of the CDM Regulations[31] that:

17.—(1) The client shall ensure that the CDM coordinator is provided with all the health and safety information in the client's possession (or which is reasonably obtainable) relating to the project which is

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[29] Confined Space Regulations 1997, UK, http://www.legislation.gov.uk/uksi/1997/1713/regulation/5/made

[30] The Merchant Shipping (Code of Safe Working Practices for Merchant Seamen) Regulations 1998, page 236, Maritime and Coastguard Agency, the Department for Transport UK,

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/282659/coswp2010.pdf

[31] The Construction (Design and Management) Regulations, page 10, Feb 2007, UK

http://www.legislation.gov.uk/uksi/2007/320/pdfs/uksi_20070320_en.pdf likely to be needed for inclusion in the health and safety file, including information specified in regulation 4(9)(c) of the Control of Asbestos Regulations 2006(a).

(2) Where a single health and safety file relates to more than one project, site or structure, or where it includes other related information, the client shall ensure that the information relating to each site or structure can be easily identified.

(3) The client shall take reasonable steps to ensure that after the construction phase the information in the health and safety file:

a. is kept available for inspection by any person who may need it to comply with the relevant statutory provisions; and
b. is revised as often as may be appropriate to incorporate any relevant new information.

(4) It shall be sufficient compliance with paragraph (3)(a) by a client who disposes of his entire interest in the structure if he delivers the health and safety file to the person who acquires his interest in it and ensures that he is aware of the nature and purpose of the file.

A CDM coordinator, who is normally a health and safety professional, is appointed by the project client on notifiable project, which involves more than 30 days or 500 man days of construction work. A CDM coordinator is required to undertake the following actions:

a. Advice and assistance: give advice and assistance to the client on what he needs to do to comply with CDM Regulations 2007
b. Co-ordination and co-operation: ensure that arrangements are in place for co-ordination and co-operation during the planning and preparation phase of a wind farm construction project
c. Pre-construction information: identify and collect the pre-construction information
d. Designer compliance: take steps to ensure that designers comply with their CDM duties

The overall role of a CDM coordinator is to ensure compliance to CDM Regulations 2007 and ensure safety in the design and construction of an OWF and ONWF project. However, it should be noted that following the review of the CDM Regulations (2007), the UK HSE has recommended significant changes to the current legislation, which will come in force in 2015. One of the changes involves replacement of the CDM coordinator role with the Principal Designer. Design professionals have expressed some concerns about the ability of designers to discharge the proposed "Principal Designer" function (to replace the CDM Coordinator) but the HSE has decided that, on balance, this proposed replacement is appropriate. It notes that the default position will not change in that the pre-construction co-ordination function will be delegated to a third party (still) and acknowledges that this will at least be the case in the first two years following the changes.

While the entire CDM Regulations 2007 applies to all OWF and ONWF construction projects that require more than 30 days or 500 man days of construction work, the certain sections of the regulations address construction activities involving inspection. We summarize those sections in this report.

2.1.9. Offshore Operations

The safety of crew on transfer vessels and transport boats is of great importance during transportation and installation of wind farm components such as foundation, tower sections, nacelles, blades, offshore substation, array cables and export cable. Countries with maritime regulations have long addressed the safety aspect of offshore activities.

In the UK, Merchant Shipping (Code of Safe Working Practices for Merchant Seamen) Regulations, 1998[32] requires a set of inspections to be carried out to ensure crew safety. The regulations call for the following inspections:

> *3.10.6 The Regulations require the safety officer to carry out health and safety inspections of each accessible part of the ship at least once every three months, or more frequently if there have been substantial changes in the conditions of work.*
>
> *3.10.8 Deciding whether "substantial changes in the conditions of work" have taken place is a matter of judgment. Changes are not limited to physical matters such as new machinery but can also include changes in working practices or the presence of possible new hazards. A record should be kept of all inspections.*
>
> *3.10.9 It is not necessary to complete an inspection of the whole ship at one time, as long as each accessible part of the ship is inspected every three months. It may be easier to get quick and effective action on recommendations arising out of an inspection, if one section is dealt with at a time. When inspecting a section the safety officer should be accompanied by the officer or petty officer responsible for it.*
>
> *3.10.10 Before beginning any inspection, previous reports of inspections of the particular section should be read, together with the recommendations made and the subsequent action taken. The control measures identified in any relevant risk assessment should also be read, and compliance with them checked during the inspection. Any recurring problems should be noted and, in particular, recommendations for action which have not been put into place. It is important, however, not to allow the findings of previous inspections to prejudice any new recommendations.*
>
> *4.2.9 A competent person should inspect each item of protective equipment at regular intervals and in all cases before and after use. All inspections should be recorded. Equipment should always be properly stowed in a safe place after use.*

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[32] Merchant Shipping (Code of Safe Working Practices for Merchant Seamen) Regulations, 1998,

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/282659/coswp2010.pdf

7.2.2 Maintenance should include regular inspections by a competent person as dealt with in paragraph 7.1. Where there is any suspicion that any work equipment is not working properly, or has been subjected to any treatment likely to cause damage, it should be taken out of service until it can be inspected and any necessary repairs or maintenance undertaken.

7.3.1 Where the safety of work equipment depends on the installation conditions, it should be inspected by a competent person after initial installation, or after re-assembly at a new site or in a new location, and before being put into service for the first time, to ensure that it has been installed correctly, in accordance with any manufacturer's instructions, and is safe to use. In this context "inspection" means the carrying out of such visual or more rigorous inspection by a competent person and may include testing where this is considered appropriate.

7.3.2 Inspections should cover factors such as the standard of welding or other fixing and materials used, together with the strength of any part of the ship to which it is attached and which supports it. Account should also be taken of any inspection requirements or guidance produced by the manufacturer. Work equipment should be re-inspected at regular intervals, not exceeding 5 years, or more frequently if recommended by the manufacturer, to ensure that no deterioration in its installation has occurred.

7.3.5 The results of all inspections are to be recorded and all such records are to be retained, readily available for inspection, until such time as a further inspection has been undertaken and recorded.

7.3.6 Where any ship's work equipment is to be used outside the ship, or work equipment from outside the ship is obtained for use on the ship, it must be accompanied by physical evidence that the last inspection required to be carried out under the Merchant Shipping and Fishing Vessels (provision and Use of work equipment) Regulations 2006 has actually been carried out. In this context "used outside the ship" includes use on the quayside, dock or jetty or on board another ship; and/or operated by workers who are employed by another person.

7.3.7 Any work equipment used for lifting loads, including personnel, is also subject to the provisions of the Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2006, which set out specific requirements for the "inspection," "testing" and "thorough examination" of such lifting equipment, etc. This aspect is dealt with in detail in Chapter 21 of this Code.

10.3.8 In addition to the statutory inspection, fire appliances, fire and watertight doors, other closing appliances, and fire detection and alarm systems which have not been used in the drill should be inspected, either at the time of the drill or immediately afterwards.

10.7.6 A careful inspection for structural damage should be carried out after dealing with spillages of highly corrosive substances.

2.1.9.1. Principal Contractor

The principal contractor is the one that plans, manages and monitors the construction phase of (OWF and ONWF) project. In the paragraph 24,[33] of CDM Regulations 2007 the principal contractor's duty in relation to co-operation and consultation with workers are addressed. It states that:

a. Make and maintain arrangements which will enable him and the workers engaged in the construction work to co-operate effectively in promoting and developing measures to ensure the health, safety and welfare of the workers and in checking the effectiveness of such measures

b. Consult those workers or their representatives in good time on matters connected with the project which may affect their health, safety or welfare, so far as they or their representatives are not so consulted on those matters by any employer of theirs;

c. Ensure that such workers or their representatives can inspect and take copies of any information which the principal contractor has, or which these Regulations require to be provided to him, which relates to the planning and management of the project, or which otherwise may affect their health, safety or welfare at the site, except any information

   i. the disclosure of which would be against the interests of national security,
   ii. which he could not disclose without contravening a prohibition imposed by or under an enactment,
   iii. relating specifically to an individual, unless he has consented to its being disclosed,
   iv. the disclosure of which would, for reasons other than its effect on health, safety or welfare at work, cause substantial injury to his undertaking or, where the information was supplied to him by some other person, to the undertaking of that other person, or
   v. obtained by him for the purpose of bringing, prosecuting or defending any legal proceedings.

2.1.9.2. Excavation

UK CDM Regulation par.31.4.b[34] requires *"Construction work not to be carried out in an excavation where any supports or battering have been provided pursuant to paragraph:*

(1) (All practicable steps shall be taken, where necessary to prevent danger to any person, including, where necessary, the provision of supports or battering) unless:

a. the excavation and any work equipment and materials which affect its safety, have been inspected by a competent person

   i. *at the start of the shift in which the work is to be carried out,*

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[33] The Construction (Design and Management) Regulations, page 14, Feb 2007, UK

[34] The Construction (Design and Management) Regulations, page 16, Feb 2007, UK

ii. *after any event likely to have affected the strength or stability of the excavation, and*

iii. *after any material unintentionally falls or is dislodged; and*

b. *the person who carried out the inspection is satisfied that the work can be carried out there safely.*

The regulation does not make any comment on who should be in charge of the inspections as this decision is left with the Client (project owner); instead the regulations demands that inspections to be carried out by a competent person, which is the common approach of the UK HSE.

2.1.9.3. Cofferdams and Caissons

Paragraph 32[35] of the UK CDM Regulations demands the cofferdam or caisson, and any work equipment and materials which affect its safety to be inspected by a competent person. It is stipulated in this paragraph that:

(1) Every cofferdam or caisson shall be

a. *of suitable design and construction;*

b. *appropriately equipped so that workers can gain shelter or escape if water or materials enter it; and*

c. *properly maintained.*

(2) A cofferdam or caisson shall be used to carry out construction work only if

a. *the cofferdam or caisson, and any work equipment and materials which affect its safety, have been inspected by a competent person*

i. *at the start of the shift in which the work is to be carried out, and*

ii. *after any event likely to have affected the strength or stability of the cofferdam or caisson; and*

b. *the person who carried out the inspection is satisfied that the work can be safely carried out there.*

(3) Where the person who carried out the inspection has under regulation 33(1)(a) informed the person on whose behalf the inspection was carried out of any matter about which he is not satisfied, work shall not be carried out in the cofferdam or caisson until the matters have been satisfactorily remedied.

Therefore, where cofferdams and caissons are used in an OWF, there is a legal requirement to carry out inspections to ensure safe operations for the workers. In the UK, the main requirement for an inspector

[35] The Construction (Design and Management) Regulations, page 16, Feb 2007, UK

is to be "a competent person." Again the responsibility of assigning a competent person is left the principal contractor or the client.

The UK, Construction (Health, Safety and Welfare) Regulations 1996,[36] Schedule 7 Places of Work Requiring Inspection stipulates that a place of work involving cofferdams and caissons requires inspections:

i. *(i)3.Before any person carries out work at the start of every shift; and*

ii. *(ii) After any event likely to have affected the strength or stability of the cofferdam or caisson or any part thereof.*

This approach of the UK HSE provides flexibility, but also creates a degree of risk when the level of competency is misjudged in the process of selecting experienced and qualified inspectors to carry out inspection activities in OWF and ONWF projects. It is recommended for BSEE to review "Benchmarking the Competent Person in Manufacturing and Engineering Sectors"[37] issued by the UK HSE, before deciding whether to adopt the same approach or to be prescriptive in this area. The view of the UK HSE is as such that the decision on "competency" should lie with the companies hiring their own HSE specialists or assigning third parties to carry out HSE inspections, audits, reviews, etc. The UK HSE stated,[38] *"Employer must ensure that any individual performing a task on employer's behalf has the competence to do so without putting the health and safety of themselves or others at significant risk."*

2.1.9.4. Inspection Reports

UK CDM Regulations paragraph 33[39] outlines the requirements for reporting inspection results:

(1) Subject to paragraph (5), the person who carries out an inspection under par.31 or par.32 shall, before the end of the shift within which the inspection is completed:

a. *where he is not satisfied that the construction work can be carried out safely at the place inspected, inform the person for whom the inspection was carried out of any matters about which he is not satisfied; and*
b. *prepare a report which shall include the particulars set out in Schedule 3.*

(2) A person who prepares a report under paragraph (1) shall, within 24 hours of completing the inspection to which the report relates, provide the report or a copy of it to the person on whose behalf the inspection was carried out.

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[36] Construction (Health, Safety and Welfare) Regulations 1996, UK http://www.legislation.gov.uk/uksi/1996/1592/schedule/7/made

[37] Research Report 121 - Benchmarking the Competent Person in Manufacturing and Engineering Sectors, Engineering Employers Federation (South), 2003, UK http://www.hse.gov.uk/research/rrpdf/rr121.pdf

[38] http://www.hse.gov.uk/competence/

[39] The Construction (Design and Management) Regulations, page 17, Feb 2007, UK

(3) Where the person owing a duty under paragraph (1) or (2) is an employee or works under the control of another, his employer or, as the case may be, the person under whose control he works shall ensure that he performs the duty.

(4) The person on whose behalf the inspection was carried out shall:

- *a. keep the report or a copy of it available for inspection by an inspector appointed under section 19 of the UK Health and Safety at Work etc. Act 1974(a):*
  - *i. at the site of the place of work in respect of which the inspection was carried out until that work is completed, and*
  - *ii. after that for 3 months, and send to the inspector such extracts from or copies of it as the inspector may from time to time require.*

(5) Nothing in this regulation shall require as regards an inspection carried out on a place of work for the purposes of regulations 31(4)(a)(i) and 32(2)(a)(i), the preparation of more than one report within a period of 7 days.

Schedule 3 of UK CDM Regulation paragraph 33(1)(b) elaborates on the particulars to be included in an inspection report:

1. Name and address of the person on whose behalf the inspection was carried out.

2. Location of the place of work inspected.

3. Description of the place of work or part of that place inspected (including any work equipment and materials).

4. Date and time of the inspection.

5. Details of any matter identified that could give rise to a risk to the health or safety of any person.

6. Details of any action taken as a result of any matter identified in paragraph 5 above.

7. Details of any further action considered necessary.

8. Name and position of the person making the report.

2.1.9.5. Risk Assessments

The UK and most of the other European countries require risk assessments for construction and maintenance activities to be carried out before commencing any works in OWF and ONWF projects.

UK CDM Regulation Part 2 paragraph 13.(4).(b).(i)[40] lists risk assessment as part of the duties of contractors working on (offshore and onshore) construction projects:

[40] The Construction (Design and Management) Regulations, page 9, Feb 2007, UK

(4) Every contractor shall provide every worker carrying out the construction work under his control with any information and training which he needs for the particular work to be carried out safely and without risk to health, including:

(a) suitable site induction, where not provided by any principal contractor;

(b) information on the risks to their health and safety:

i. *identified by his **risk assessment** under regulation 3 of the Management of Health and Safety at Work Regulations 1999, or*

ii. *arising out of the conduct by another contractor of his undertaking and of which he is or ought reasonably to be aware*.

UK Management of Health and Safety at Work Regulations 1999, Regulation 3 Risk Assessment[41] states that:

(1) Every employer shall make a suitable and sufficient assessment of:

a. *the risks to the health and safety of his employees to which they are exposed whilst they are at work; and*

b. *the risks to the health and safety of persons not in his employment arising out of or in connection with the conduct by him of his undertaking, for the purpose of identifying the measures he needs to take to comply with the requirements and prohibitions imposed upon him by or under **the relevant statutory provisions and by Part II of the Fire Precautions (Workplace) Regulations 1997.***

(2) Every self-employed person shall make a suitable and sufficient assessment of:

a. *the risks to his own health and safety to which he is exposed whilst he is at work; and*

b. *the risks to the health and safety of persons not in his employment arising out of or in connection with the conduct by him of his undertaking, for the purpose of identifying the measures he needs to take to comply with the requirements and prohibitions imposed upon him by or under the relevant statutory provisions.*

(3) Any assessment such as is referred to in paragraph (1) or (2) shall be reviewed by the employer or self-employed person who made it if:

a. *there is reason to suspect that it is no longer valid; or*

b. *there has been a significant change in the matters to which it relates; and where as a result of any such review changes to an assessment are required, the employer or self-employed person concerned shall make them.*

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[41] The Management of Health and Safety at Work Regulations 1999, page 3, Dec 1999, UK

(4) An employer shall not employ a young person unless he has, in relation to risks to the health and safety of young persons, made or reviewed an assessment in accordance with paragraphs (1) and (5).

(5) In making or reviewing the assessment, an employer who employs or is to employ a young person shall take particular account of:

a. *the inexperience, lack of awareness of risks and immaturity of young persons;*
b. *the fitting-out and layout of the workplace and the workstation;*
c. *the nature, degree and duration of exposure to physical, biological and chemical agents;*
d. *the form, range, and use of work equipment and the way in which it is handled;*
e. *the organization of processes and activities;*
f. *the extent of the health and safety training provided or to be provided to young persons; and*
g. *risks from agents, processes and work listed in the Annex to Council Directive 94/33/EC(a) on the protection of young people at work.*

(6) Where the employer employs five or more employees, he shall record:

a. *the significant findings of the assessment; and*
b. *any group of his employees identified by it as being especially at risk*.

UK CDM Regulation Part 3 paragraph 19.(2).(a) Additional Duties of Contractors[42] stipulates contractors to provide risk assessment to the principal contractor (project owner):

(2) Every contractor shall:

a. *promptly provide the principal contractor with any information (including any relevant part of any* ***risk assessment*** *in his possession or control) which*
   i. *might affect the health or safety of any person carrying out the construction work or of any person who may be affected by it,*
   ii. *might justify a review of the construction phase plan, or*
   iii. *has been identified for inclusion in the health and safety file in pursuance of regulation 22(1)(j)*

2.1.10. Environmental Protection

In the UK, as in the rest of Europe, there is a great focus on protection of the environment and therefore this area is heavily regulated. For example, Environmental Protection Act 1990 demands any oil spill to

[42] The Construction (Design and Management) Regulations, page 11, Feb 2007, UK

ground or streams to be reported to regional environmental protection agency. Environmental Protection Act 1990 78B, Identification of Contaminated Land[43] stipulates:

(1)Every local authority shall cause its area to be inspected from time to time for the purpose

a. *of identifying contaminated land and*
b. *of enabling the authority to decide whether any such land is land which is required to be designated as a special site.*

This regulation focuses on monitoring the condition of land, including ONWF sites, and also ensuring that the land is designated as a special site, such preservation area, bog land, etc. A recent project involving installation and operation of an ONWF highlights the importance of complying with environmental regulations from the planning stage. Derrybrien ONWF in Ireland, which was planned for 71 turbines (60 MW), is an example of errors in site assessment at the project conception stage. Having obtained full planning permission, the project commenced production in July 2003, but was severely impacted when a landslide occurred in October 2003 after 90% of the site roads were complete and 50% of the turbine foundations were in place. Although no one was injured as a result of the landslide, there was substantial damage to the fishery at the base of the slide caused by debris entering the river. The landslide also affected the forestry, unoccupied property, and road access, resulting in several months of delays. Although the landslide affected only 1% of the wind farm site, the consequences were severe. A subsequent investigation found a combination of contributing factors, including a zone of weak peat with a natural drainage channel, and activity associated with the construction of the wind farm. The report identified a number of changes to construction work practices that were put in place before resuming work, and geotechnical consultants were engaged to monitor every stage of construction of the wind farm on a full-time basis. The landslide moved nearly half a million cubic meters of earth, polluted a river and killed 50,000 fish. In 2008, the European Court of Justice found that the landslide occurred because a proper environmental impact assessment had not been carried out prior to construction of the wind farm. The court argued in effect that the application of Irish law was too loose. The Irish Government argued it was caused by failures in construction but they accepted the court ruling.[44]

2.1.11. Electrical Safety

Safe operations of offshore substations, onshore substations and export cables are integral part of overall OWF safety.

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[43] The Environmental Protection Act 1990 78B , UK http://www.legislation.gov.uk/ukpga/1990/43/section/78B

[44] Risk Management of Wind Farm Projects, MBA Research Project, Jale Cairney, Imperial College London, Business School, London 2009

UK Electricity Safety, Quality and Continuity Regulations (Northern Ireland) 2012 Regulations[45] stipulates inspections requirements for electricity safety. It is stated in the Part 1, 5.A, Inspection of networks that:

> *5. A generator or distributor shall, so far as is reasonably practicable, inspect their network with sufficient frequency so that they are aware of what action they need to take so as to ensure compliance with these Regulations and, in the case of their substations and overhead lines, shall maintain for a period of not less than 10 years a record of such an inspection including any recommendations arising therefrom.*

UK Electricity Safety, Quality and Continuity Regulations (Northern Ireland) 2012 Regulations Part 4, Underground cables and Equipment, Regulation 15, Maps of Underground Networks stipulates the following:

(1) This regulation applies in respect of any network or part thereof, owned or operated by a generator or distributor which is below ground on land which is not under their control.

(2) Every generator or distributor shall have and, so far as is reasonably practicable, keep up to date, a map or series of maps indicating the position and depth below surface level of all networks or parts thereof which they own or operate.

(3) The generator or distributor shall make a copy of the whole or the relevant part of the map prepared or kept for the purposes of paragraph (2) available for inspection by any of

a. the Department;
b. the Department of the Environment; and
c. any other person who can show reasonable cause for requiring to inspect any part of the map, and shall, on request, provide a copy of such map or part of the map.

UK Electricity Safety, Quality and Continuity Regulations (Northern Ireland) 2012 Regulations Part 8, Regulation 31, Inspections, etc. for the Department addresses the requirements for making relevant documentation available for inspections.

> *(1) A generator or distributor whose equipment is subject to inspection, test or examination for the purpose of ascertaining whether a breach of these Regulations may have occurred, by an inspector appointed under Article 33 of the Electricity (Northern Ireland) Order 1992, shall afford reasonable facilities therefor.*
>
> *(2) A generator or distributor shall provide such information to the inspector as they may require for the purposes of performing their functions under this regulation*.

[45] The Electricity Safety, Quality and Continuity Regulations (Northern Ireland) 2012, The Health and Safety Executive, UK, 2012 http://www.legislation.gov.uk/nisr/2012/381/pdfs/nisr_20120381_en.pdf

2.1.12. Diving

Where subsea operations involving divers are undertaken, the Diving at Work Regulations[46] impose a duty on the Diving Contractor to ensure that suitable emergency response and first aid provision is in place, to cope with foreseeable emergencies on the project. The regulations also specify the first aid training requirements for divers, and the provision of diver medics in each dive team[47].

Diving at Work Regulations, Regulation 6, Duties of Diving Contractor stipulates as following:

(1) The diving contractor shall ensure, so far as is reasonably practicable, that the diving project is planned, managed and conducted in a manner which protects the health and safety of all persons taking part in that project.

(2) The diving contractor shall:

(a) Ensure that, before the commencement of the diving project, a diving project plan is prepared in respect of that project in accordance with regulation 8 and that the plan is thereafter updated as necessary during the continuance of the project.

(b) Before the commencement of any diving operation:

(i) Appoint a person to supervise that operation in accordance with regulation 9

(ii) Make a written record of that appointment

(iii) Ensure that the person appointed is supplied with a copy of any part of the diving project plan which relates to that operation.

(c) As soon as possible after the appointment of a supervisor, provide that supervisor with a written record of his appointment.

(3) The diving contractor shall:

(a) Ensure that there are sufficient people with suitable competence to carry out safely and without risk to health both the diving project and any action (including the giving of first-aid) which may be necessary in the event of a reasonably foreseeable emergency connected with the diving project.

(b) Ensure that suitable and sufficient plant is available whenever needed to carry out safely and without risk to health both the diving project and any action (including the giving of first-aid) which may be necessary in the event of a reasonably foreseeable emergency connected with the diving project.

(c) Ensure that the plant made available under sub-paragraph (b) is maintained in a safe working condition.

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[46] Diving at Work Regulations 1997, UK Health and Safety Executive, http://www.legislation.gov.uk/uksi/1997/2776/contents/made

[47] Offshore Marine HS Guidelines 2014, RenewableUK, http://www.renewableuk.com/en/publications/index.cfm/2013-03-13-hs-guidelines-offshore-wind-marine-energy

(d) Ensure, so far as reasonably practicable, that any person taking part in the diving project complies with the requirements and prohibitions imposed on him by or under the relevant statutory provisions and observes the provisions of the diving project plan.

(e) Ensure that a record containing the required particulars is kept for each diving operation.

(f) Retain the diving operation record in his possession for at least two years after the date of the last entry in it.

(4) In this regulation, the "required particulars" means such particulars as are approved for the time being in writing by the Executive for the purposes of sub-paragraph 3(e); and any such approval may be given generally or in respect of any diving project or class of diving projects.

Whereas it is stated in the Regulation 13, Duties of and restrictions on persons engaged in a diving project that:

(1) No person shall dive in a diving project:

(a) Unless he is competent to carry out safely and without risk to health any activity he may reasonably expect to carry out while taking part in the diving project.

(b) If he knows of anything (including any illness or medical condition) which makes him unfit to dive.

(2) Every person engaged in a diving project shall comply with:

(a) Any directions given to him by a supervisor under regulation 11.

(b) Where they would not conflict with those directions, any instructions applicable to him in the diving project plan.

Diving at Work Regulations, Regulation 14, Approved Qualifications stipulates the following:

(1) The Executive may approve in writing such qualification as it considers suitable for the purpose of ensuring the adequate competence of divers for the purposes of regulation 12(1)(a).

(2) Any approval given under paragraph (1) may be limited to any diver or class of divers or any dive or class of dive, may be subject to conditions or limited to time, and may be revoked in writing by the Executive at any time.

(3) An approved qualification shall not be valid for the purposes of regulation 12(1)(a) unless any limitation or any condition as to the approval of the qualification under this regulation is satisfied or complied with and the approval has not been revoked.

Diving at Work Regulations, Regulation 15, Certificate of Medical Fitness to Dive also stipulates the following:

(1) A certificate of medical fitness to dive is a certificate from a medical examiner of divers (or from the Executive following an appeal under paragraph (4)) that the person issuing the certificate considers the person named in the certificate to be fit to dive.

(2) A certificate of medical fitness to dive shall state:

(a) The period (which shall not exceed 12 months) during which the person issuing the certificate considers the person named in the certificate will remain fit to dive.

(b) Any other limitations as to the nature or category of diving to which it relates.

(3) A certificate of medical fitness to dive may be subject to conditions stated in the certificate and may be revoked at any time on medical grounds by a medical examiner of divers or the Executive.

(4) Where a certificate of medical fitness to dive is:

(a) refused,

(b) granted subject to limitations under paragraph (2), or

(c) subjected to conditions or revoked under paragraph (3).

by a medical examiner of divers, the person who applied for or holds the certificate may, within 28 days of the decision in question, appeal to the Executive against that decision; and the Executive shall thereupon review the decision and if satisfied that the decision should be reversed or altered shall issue a certificate to that effect.

(5) A certificate of medical fitness to dive shall not be valid unless any limitation or any condition stated in it is satisfied or complied with and it has neither expired nor been revoked.

(6) In this regulation, "medical examiner of divers" means a medical practitioner who is, or who falls within a class of medical practitioners which is, for the time being, approved in writing by the Executive for the purposes of this regulation; and any such approval may be given generally or restricted to any class of diver or dive.

2.2. Switzerland, Italy, France, Bulgaria Regulatory Requirements for Inspections, Audits & Evaluations

In addition to the review of UK, German and Danish HSE regulations, the HSE regulations of Switzerland, Italy, France and Bulgaria were also reviewed with regards to wind farm installation as those four countries provide good representations of European legislative systems. Bulgaria was particularly selected in this process because Bulgaria recently upgraded its legislative system in the process of EU accessing[48] (Bulgaria joined the EU in January 2007), hence its legislative system represents average EU member state regulations.

Relevant HSE regulations were identified and listed in the following appendices. Those regulations set the minimum requirements which are subject to inspections, audits and assessment. It should be noted that the web-links provided, where possible, in the MS Excel files take the reader to the regulations published in the official language of the country.

[48] All countries wishing to join the EU must abide by the accession criteria or the Copenhagen criteria, on which the Commission's opinion on any application for accession is based. One of the criteria is to demonstrate the ability to assume the obligations of a Member State stemming from the law and policies of the EU which include subscribing to the Union's political, economic and monetary aims.

- Switzerland: Please see Appendix F, Swiss Regulations.
- Italy: Please see Appendix G, Italian Regulations
- France: Please see Appendix H, French Regulations
- Bulgaria: Please see Appendix I, Bulgarian Regulations

Like in the UK, there are only few HSE regulations and inspection requirements that are specific to wind turbines, as each country resorted to applying existing national HSE regulations for wind farm developments and operations while observing the standards set by relevant national and international organizations such as RenewableUK, International Electrotechnical Commission (IEC).

2.3.German Regulatory Requirements for Inspections, Audits & Evaluations

This section addresses what the regulations of domestic and international regulators say about offshore and onshore wind inspections in Germany.

In Germany, statutory inspection requirements for offshore wind turbines and wind farms are laid down in the requirements of the Federal Maritime and Hydrographic Agency (Bundesamt für Seeschifffahrt und Hydrographie – BSH).

Based on the reviewed documents, the BSH will issue the 1st release for the development phase of the wind farm, the 2nd release for the Basic Design in the design phase, the 3rd release for the implementation planning in the design phase, and after the manufacturing (production), transport, installation and commissioning the operations release (operating permit) for the wind farm.

The standard "Design of Offshore Wind Turbines" and the "Guidance for use of the of BSH standard 'Design of Offshore Wind Turbines'" are intended to provide legal and planning security for development, design, implementation, operation and decommissioning of offshore wind farms within the scope of the Marine Facilities Ordinance .

To maintain the operating permit for the offshore wind farm, annual inspections of the operating wind farm are required by the BSH.

According to the above-mentioned BSH standards, the entire system (turbine and support structure) shall be inspected in detail as part of the periodic inspections. A specific checklist for the facility and site shall be prepared for the test on the basis of the technical documents, and shall also contain the evaluation criteria. The intervals for recurrent tests shall be defined. Periodic inspections shall be performed annually on 25% of the offshore wind turbines of an offshore wind farm, so that all offshore wind turbines will have been inspected after each block of four years. Central structures such as the transformer substation shall be inspected annually, while deviation from the annual inspection is permitted for other individual structures. The inspection shall be performed by suitable experts.

The following documents, at least, shall be inspected as part of the periodic inspections:

a. Test reports or certification reports with all appendices and supplements
b. Construction approval
c. Operating permit

d. Operating instructions
e. Commissioning report
f. Filled-in technical maintenance specifications for the OWF including the support structure and scour protection (maintenance logs)
g. Reports on previous recurrent tests or condition inspections
h. Certificate of the oil quality
i. Documentation of modifications/repairs made to the installation and, if necessary, approvals

A visual inspection of the installation shall be performed involving inspection of the individual installation components including the rotor blade and the underwater structure as well as the scour protection from immediate proximity, the underwater structure shall be inspected by divers or with a camera mounted on a remotely operated vehicle (ROV). The points to be inspected shall be cleaned or exposed as required.

At the same time, the stability of the installation against collapse, and the function of both the safety system and the brake systems shall be tested. The items covered by periodic inspections are specified as follows in Table 2 below.

Assembly	Scope
Rotor blade	Damage to the surface, cracks, structural inconsistencies of the blade body (inspection from a lifting platform or climbing device: Visual assessment and inspection of the structure using suitable processes [e.g., knocking, ultrasound]). Tightening torque of screw connections. Damage to the lightning protection equipment.
Drivetrain	Leaks, unusual noises, condition of the corrosion protection, lubrication condition, tightening torque of screw connections. Condition of the gear unit (oil sample if necessary).
Nacelle and components that carry force and torque	Corrosion, cracks, unusual noises, lubrication condition, tightening torque of screw connections.
Hydraulic system, pneumatic system	Damage, leaks, corrosion, function.
Support structure (tower, underwater structure, foundation)	Corrosion, cracks, tightening torques of screw connections, unacceptable scouring, position.
Safety equipment, measuring sensors and brake systems	Function checks, compliance with limit values, damage, wear.
System control and Electrotechnical components including transformer, station and switchgear	Connections, attachment, function, corrosion, contamination.
Documents	Completeness, compliance with regulations, implementation, test documents, regular undertaking of maintenance, undertaking of any modifications/repairs according to authorization.

Table 2 – Periodic Inspection Scope for WTGs

Onshore wind turbines have to seek Type Approval according to the "Richtlinie für Windenergieanlagen - Einwirkungen und Standsicherheitsnachweise für Turm und Gründung"[49] the "German Center of Competence in Civil Engineering" (https://www.dibt.de/en/DIBt/DIBt.html).

This "Guideline for wind turbines" also regulates the periodic monitoring of the wind turbines.

Periodic monitoring is to be carried out in regular intervals and the inspection has to cover the entire wind turbine, including machinery, rotor blades, electrical installation of the operation and safety system, safety devices, tower and foundation to assess the structural integrity. In addition, it has to be checked that the safety related thresholds are within their (certified) limits.

The periodic monitoring has to take into account the requirements of the maintenance procedure and the corresponding Certification Reports of the Type Approval.

The intervals are laid down in the corresponding Certification Reports (of the Type Approval). As a rule, the periodic monitoring inspection has to be performed every second year, but the interval can be extended to every fourth year, if authorized experts from the wind turbine manufacturer carry out continuous monitoring and annual maintenance.

The complete turbine shall be checked by visual inspection whereby the individual components (including tower, foundation, rotor blades) shall be examined closely and the areas to be examined shall be cleaned and/or uncovered if relevant.

Structural integrity of the wind turbine including machinery, functioning of the safety and braking system shall be checked as well (see Table 3).

At least the following documentation shall be reviewed for the periodic monitoring:

a. Approval and/or certification reports including all annexes and supplements
b. Building permit, including all annexes
c. Operating manual
d. Commissioning report
e. Maintenance report
f. Reports of previous Periodic Monitoring or other conditions surveys
g. Proof of oil quality
h. Documentation of modification/repairs of the turbine an necessary approvals

Assembly	Inspection for Possible Defects
Rotor blade	- Surface damage, cracks, structural discontinuities (visual and structural examination using suitable methods [e.g., tapping, ultrasonic testing]) - Pre-tensioning of bolts - Condition of the lightning protection system as well as indications of any

[49] "Richtlinie für Windenergieanlagen - Einwirkungen und Standsicherheitsnachweise für Turm und Gründung" the "German Center of Competence in Civial Engineering", https://www.dibt.de/en/DIBt/DIBt.html

	lightning strikes
Drive train	- Leakages, unusual noises, vibrations, condition of corrosion protection, greasing, pre-tensioning of bolts - Condition of the gearing (oil sample)
Nacelle and force – and moment – transmitting components	- Corrosion, cracks, unusual noises, greasing - Pre-tensioning of bolts
Hydraulic system, pneumatic system	- Damage, leakages, corrosion - Function
Safety devices, sensors and breaking systems	- Functional checks, compliance with the limiting values - Damage, wear
Electrical installation including control system	- Protocols of inspections performed according to the scope described in IEC 60364-6 since the last Periodic Monitoring - Availability of the up-to-date circuit diagrams - Corrosion, protection against direct contact, scorch marks, damages and deterioration of electrical installations including electrical cabinets, cable routing and fixing, cable harness in yaw section, connection and housing of sensors and actuators - Grounding of electrical components - Integrity of hazard beacon and emergency light - Settings of protection devices - Plausibility function checks of control system including verification of limit values and error messages - Lock of transformer room - Condition and fixing of power transformers - Availability of personal safety equipment against electrical shock - Labelling (warning signs, danger notices, identification of cables and devices)
Lightning protection system	- Protocols of inspections performed according to the scope described in IEC 61400-24 since the last Periodic Monitoring - Condition of the air termination and down conduction system as well as indications of any lighting strikes. This mainly includes: condition of receptors, condition of lightning rods, condition of foundation connection lugs, corrosion of earth electrodes, conditions of Surge Protection Devices (SPD), condition of sliding contacts, earth brushes and spark gaps, condition of connections and fixings, condition of down conductors.
Tower and foundation	- Corrosion, cracks - Pre-tensioning of bolts - Covering of foundation

Table 3 – Scope of Inspections for Periodic Monitoring of WTGs

With regards to Health and Safety and inspection of PPE, ladders, fall arrest system, work platforms, confined space, environmental protection and electrical safety, the following regulations/standards have to be taken into account:

- Wind turbines – Protective measures – Requirements for design, operation and maintenance; FprEN 50308:2013[50]

This standard specifies requirements for protective measures relating to health and safety of persons, domestic animals and property, to be incorporated into the design, operation and maintenance of wind turbines. The requirements cover the potential danger zones inside and in the environment of a wind turbine where persons, domestic animals and property may be exposed to hazards from the wind turbine. This standard covers the safety issues of the wind turbine itself and the directly related material, equipment and processes essential for the safe operation of the complete system. This also includes switchgear outside the tower, internal grid, grid connection, and any means of access.

- Deutsche Gesetzliche Unfallversicherung e.V. DGUV Information 203-007 – Windenergieanlagen (bisher: BGI 657)51

This DGUV Information 203-007 – Windenergieanlagen (bisher: Berufsgenossenschaftlichen Information [BGI] 657) (*DGUV Information 203-007 – Wind Turbines (formally known as: BGI 657)* covers hazard identification according to the German Safety and Health Act (Deutsches Arbeitsschutzgesetz). It is applicable to the construction, assembly/disassembly, operation and maintenance of onshore and offshore wind turbines.

In the following section, additional information are given for components or areas which are not or not fully covered by aforesaid section.

2.3.1. Lifting Equipment

According to the German Occupational Safety Act "Betriebssicherheitsverordnung (BetrSichV)" Periodic Monitoring of lifting equipment in wind turbines for personnel and goods (e.g. tools) is to be carried every 4 years – interim inspection to be done between two Periodic Monitoring surveys.

2.3.2. Hydraulic Accumulators

The Periodic Monitoring intervals for Hydraulic Accumulators has to be done as external assessment (every 1st, 2nd or 5th year), internal assessment (every 3rd or 5th year) and assessment of the strength (every 5th, 9th or 10th year) and this depends on the individual layout and capacity of the hydraulic system and has to be determined individually. This is laid down in the German Occupational Safety Act "Betriebssicherheitsverordnung (BetrSichV)" §15 (Paragraph 15).

[50] Wind turbines - Protective measures - Requirements for design, operation and maintenance; FprEN 50308:2013

[51] DGUV Information 203-007 - Windenergieanlagen (bisher: BGI 657), http://www.arbeitssicherheit.de/de/html/library/document/5004841,1

2.3.3. Fire Extinguisher

According to DIN EN 3, the functioning of portable fire extinguishers has to be checked every two years in accordance with DIN EN 3. This rule applies to all portable fire extinguishers, which are stationed on onshore and offshore wind farms in Germany.

2.3.4. PPE and Fall Arrest Systems

Before each use, PPE has to be visually inspected with regards to proper conditions and functionality by the individual user. Every twelve months the PPE has to be checked by a competent person. This is laid down in the BG provision, regulation, information and axiom.[52]

2.4. Danish Regulatory Requirements for Inspections, Audits & Evaluations

In this section we address what the regulations of domestic and international regulators say about offshore and onshore wind inspections in Denmark.

The whole process, from construction, production and operation of the wind turbines, is included in the certification scheme (Executive Order on a technical certification scheme for wind turbines no. 73 of January 25th 2013 and Guidelines for Executive Order on a technical certification scheme for wind turbines no. 73 of January 25th 2013), which applies to all onshore and offshore wind turbines types.

The purpose of this Executive Order is to ensure that wind turbines installed onshore, in Danish territorial waters and in the Exclusive Economic Zone, and which are used for the purpose of energy production, meet the requirements set out for energy production, safety and the environment, and that the wind turbines are serviced and maintained as prescribed.

This Executive Order shall cover the individual wind turbine, including the tower, foundations, electro-technical installations, and transformers, up to and including turbine connection terminals to the electricity supply grid, including components for leading cables away from the wind turbine.

Before the wind turbine is placed on the market or put into service, the producer or the supplier of the wind turbine shall carry out CE marking, as well as ensure that the wind turbine comes with an EC statement of compliance upon delivery in order to meet the requirements for safety and health, cf. the Executive Order on the design of technical equipment. The producer or the supplier shall be able to document to the Danish Working Environment Authority compliance with this Executive Order.

Documentation of compliance with requirements for wind turbines under other legislation, including the Building Act and the Environmental Protection Act, the Electricity Supply Act and the High Voltage Executive Order, shall be submitted to the competent authorities before the erection of the wind turbine.

[52] BG provision, regulation, information and axiom, http://www.bgbau-medien.de/struktur/inh_gese.htm

Certification of wind turbines with a rotor swept area of more than 40m² (> 7m in diameter) shall, as a minimum, include requirements corresponding to the mandatory modules and requirements for type or prototype certification stipulated in European standard DS/EN 61400-22.

Certification as mentioned in above shall also include a source noise measurement pursuant to the current Executive Order on noise from wind turbines.

Wind turbines with a rotor area of more than 200 m² (> 16m in diameter) shall be project certified upon installation. Project certification shall, as a minimum, include requirements corresponding to the mandatory modules and requirements for project certification stipulated in European standard DS/EN 61400-22.

In addition to the aforesaid standards and regulations additional requirements are to be met and are subject to a continuous update. Current regulations are to be checked on the website of the Danish Energy Agency (http://www.vindmoellegodkendelse.dk/DK/regelsaetogrekom.htm).

As a rule the necessary and regular inspections have to be carried out according to the service and maintenance instruction of the individual wind turbine type; at least the following should be covered:

2.4.1. Inspections per Annum

a. The machine/ main frame shall be inspected for cracks in congested and at welds.

b. The main shaft to be inspected for scratches and rust. The area in front of the front main bearing is important. There must be no scratches and rust.

c. The yaw-system to be inspected for wear and the backlash in the bearing to be measured.

d. The tower to be inspected for cracks in the welds.

e. Bolted joints are to be checked for looseness and pretension.

f. The foundation is to be inspected for cracks. Seals are to be checked for functionality.

g. Any bolted joints of the foundation are to be inspected for rust and corrosion.

2.4.2. Inspections every 3 Years

Rotor blades are to be inspected by visual inspection at close range; possibly using techniques involving camera or tele/photo drone and subsequent evaluations. These inspections are performed by visual inspection of the required components and details.

The extended service intervals with associated check-list shall be forwarded to the owner and registered in service report. The Secretariat will continuously update examples (which may be wind turbine specific) and can be downloaded from the website of the Danish Energy Agency's Secretariat for Wind Turbines (www.vindmoellegodkendelse.dk).

In Denmark Health, Safety and Environmental protection aspects are regulated by the Danish Working Environment Authority (Arbejdstilsynet, http://arbejdstilsynet.dk/da/).

The external document structure of the Danish Working Environment Authority (WEA) (http://engelsk.arbejdstilsynet.dk/en/Regulations.aspx) distinguishes between documents of a legal nature and documents of an informative nature.

Documents of a legal nature include Acts, Executive Orders and WEA Guidelines.

The mission statement is to contribute to a safe, healthy and stimulating working environment through effective inspection, targeted regulation and information, while the vision statement is to focus on the most important working environment problems and target efforts towards enterprises with a problematic working environment.

2.4.3. Acts

The Danish Working Environment Act (http://engelsk.arbejdstilsynet.dk/en/Regulations/acts/Working-Environment-Act.aspx) includes general provisions on the working environment. The Act is binding on citizens and any violation of the rules is therefore subject to legal sanctions.

The Offshore Safety Act (http://engelsk.arbejdstilsynet.dk/en/Regulations.aspx) regulates safety of offshore installations, the working environment on the installations and other health conditions.

2.4.4. Executive Orders

According to Danish regulations the Act is implemented through Executive Orders, which can be found in the following website link. (http://engelsk.arbejdstilsynet.dk/en/Regulations/Executive-Orders.aspx). Executive Orders are binding on citizens and any violation of the rules is therefore subject to legal sanctions.

2.4.5. WEA Guidelines

WEA Guidelines (http://engelsk.arbejdstilsynet.dk/en/Regulations/Guidelines.aspx) describe how the regulations laid down in Danish working environment legislation are to be interpreted. WEA Guidelines are not, in themselves, binding on citizens; they are, however, based on regulations (Acts and Executive Orders) that are binding. The Danish Working Environment Authority will take no further action in situations where an enterprise, for example, has acted in accordance with the relevant WEA Guidelines. The old WEA publications (i.e. WEA (previously WES) Guidelines/WEA (previously WES) Information Notices) will be superseded by WEA Guidelines. There will be a transitional period during which certain "old" WEA publications will still be applicable (i.e. WEA (WES) Guidelines/WEA (WES) Information Notices). The "old" publications, like the WEA Guidelines, describe how to comply with working environment legislation. Eventually, these older publications will all be superseded by WEA Guidelines.

In the following subsection reference is made to aforesaid regulation of the Danish Working Environment Authority, if not mentioned differently.

2.4.5.1. Lifting Equipment

According to the Order of the Danish Working Environment Authority No. 1101 lifting equipment must be kept in a condition that ensures health and safety and must be inspected and maintained according to the supplier's recommendations.

2.4.5.2. *Fire Extinguisher*

According to DS EN 3 the functioning of fire extinguishers has to be checked every 2 years.

2.4.5.3. *PPE, Service Lifts, Ladders, Work Platforms, Fall Arrest System*

The rules for technical equipment are laid down in the “Order on the design of technical equipment” as well as in the “Executive Order on the Conditions at Permanent Places of Work”.

Before each use PPE has to be visually inspected with regards to proper conditions and functionality by the individual user.

It is the turbine owner’s responsibility that the inspection of PPE, service lifts, ladders, fall arrest system is done at least one time every 12 months.

2.4.5.4. *Work Equipment*

Requirements of work equipment are laid down in Executive Order on the Use of Work Equipment.

2.4.5.5. *Offshore Operations*

The Danish Working Environment Authority supervises the health and safety aspects of the offshore installations (http://engelsk.arbejdstilsynet.dk/en/offshore.aspx).

2.5.U.S. Regulatory Requirements for Inspections, Audits & Evaluations

2.5.1. Federal jurisdiction

In the U.S., regulatory responsibility for inspections or audits or evaluations of offshore turbines currently resides with BSEE. Originally, this responsibility lay with the Minerals Management Service (MMS), which was then transferred to its succeeding agency, the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE). But this responsibility has now been shifted to BSEE.

Occupational Safety and Health Administration (OSHA), Bureau of Ocean Energy Management (BOEM) and the U.S. Coast Guard (USCG) are the other three federal agencies who have certain jurisdictional oversights with OWF operations. OSHA still has authority over worker safety in onshore wind project and in offshore wind projects in state waters. The USCG still has authority over the auxiliary vessels and support vessels.

With the issuance of 30 CFR 585, the shift was toward BOEM, but the final responsibility is understood to fall upon BSEE. This clarification of jurisdictional scope will need to be codified and published in the CFR.

2.5.2. BSEE

The primary US code covering OWF in OCS is covered in Title 30 CFR Part 585. As stated above, this was originally put within BOEM scope, but has shifted to BSEE. Furthermore, specific rulemaking is expected to follow and will also be issued by BSEE in the future. This deeper elaboration should provide a clear distinction of the roles and responsibilities of BSEE, and the expectations of each of the parties in the OWF industry.

2.5.3. OSHA

OSHA is part of the Labor department. This office was established by the Occupational Safety and Health Act of 1970. It rules and regulations are published in the Federal Register under Title 29, Part 1910. OSHA is the federal agency that covers worker health and safety issues in most industrial applications in the U.S. But for offshore installation sites in federal waters, it has been deemed this responsibility lies with BOEM and BSEE.

Even with the jurisdictional situation, the intent of the OSHA regulations is generally valid in the offshore wind environment and should be considered when evaluating BSEE's role in regulating this sector.

2.5.3.1. Confined Space

The section of the federal OSHA code that contains Confined Space procedures is Title 29, Section §1910.146 – Permit-required confined spaces. This section contains requirements for practices and procedures to protect employees in general industry from the hazards of entry into permit-required confined spaces.

2.5.3.2. Lockout/Tagout

The section of the federal OSHA code that covers Lockout/Tagout procedure is Title 29, Section §1910.147 – The control of hazardous energy (lockout/tagout). This standard covers the servicing and maintenance of machines and equipment in which the unexpected energization or startup of the machines or equipment, or release of stored energy, could harm employees. This standard establishes minimum performance requirements for the control of such hazardous energy.

2.5.3.3. Fall protection

The section of the federal OSHA code that covers fall protection procedures is § 1910.66, Appendix C – Personal Fall Arrest System (Section I—Mandatory; Sections II and III—Non-Mandatory). This standard covers both the sets of the mandatory and non-mandatory criteria for personal fall arrest systems used by all employees using powered platforms.

2.5.3.4. Electric Power Generation, Transmission and Distribution,

The section of the federal OSHA code that covers electric power generation, transmission and distribution is Title 29, Section §1910.269 – Electric power generation, transmission, and distribution. This section covers the operation and maintenance of electric power generation, control, transformation, transmission, and distribution lines and equipment.

2.5.3.5. Walking - Working surfaces

The section of the federal OSHA code that covers walking and working surfaces is Title 29, Section §1910.22 – Walking – Working surfaces. This section applies to all permanent places of employment, except where domestic, mining, or agricultural work only is performed.

2.5.3.6. Personal Protective Equipment

The section of the federal OSHA code that covers PPE are the following:

- §1910.132, General requirements (PPE)

- [§1910.133](), Eye and face protection
- §1910.135, Head protection
- §1910.136, Foot protection
- §1910.137, Electrical protective devices
- §1910.138, Hand protection
- §1910 Subpart I - Appendix A, References for further information (Non-mandatory)
- §1910 Subpart I - Appendix B, Non-mandatory compliance guidelines for hazard assessment and PPE selection

2.6. Japanese Regulatory Requirements for Inspections, Audits & Evaluations

As of the end of 2013, Japan had constructed 1,934 land-based wind turbine units, with a total capacity of 2,710 kilowatts. These wind turbines are designed, built, installed and maintained under the laws, the Electric Enterprises Act and the Building Standards Act implemented by the Ministry of Economy, Trade and Industry (METI). The Electric Power Safety bureau of METI who is responsible to the safety of the wind turbine legally manages and controls both the land/sea bottom-based wind turbines. While the floating wind turbines are now installed on the offshore of Fukushima shore/and in the bay of western part of Japan as experimental basis for collection of the data, there are no definitive criteria for design, building, installation and maintenance covering the floating wind turbine at this moment. As the floating wind turbine is considered as a sort of floating vessel, the equipment/structures of the floater are to be designed, built, installed and maintained for compliance with the Ship Safety Law that is issued and maintained by MLIT.

As of today, METI requires the owner/electric company who operates the wind turbine to submit, *"a prescriptions for safety (operation of wind turbine)."* The prescriptions specified the interval, scope and inspection items of periodical inspection(s) for the wind turbine are to be developed by the operator/the owner but there is no specific criteria issued by METI. However, after a few damages were reported from the land-based wind turbine (e.g., damages in blade, nacelle and/or mast) consequently induced whole collapse, METI is now considering to develop a regulation to specify the inspection interval, inspection items, inspector's license/equipment, etc. There are no specific regulations in association with the inspections, audits and evaluations in Japan at this moment, as of January 2015.

Japanese Government (JG) is developing the regulations for the floating wind turbine in line with the latest draft of IEC standards for the wind turbine. JG's direction in the rule making would be the criteria in the middle between those standards prepared by U.S. and Norway. They consider that U.S. standards are too strict to the unmanned floating structure and the Norwegian ones are too rough for protection of marine environment.

2.7. Review and Analysis of OWF Inspections, Audits & Evaluations

This section combines the inspection procedures listed under Section C.2.1.1.1, Section C.2.1.1.2 and Section C.2.1.1.3 of BSEE's work statement. In this section we perform a complete review and analysis of inspections, audits, and evaluations that are currently performed on onshore and offshore wind farm components including MetMasts, OSPs, subsea cables and offshore and onshore WTGs. We observe wind farms owners to resort to inspections in four occasions:

a. **Compliance:** Wind farm owners are obligated to ensure that the statutory inspections are carried out in accordance with applicable regulations. The statutory inspections requirements vary from country to country, but typical statutory inspections for wind farms include inspections of hydraulic accumulators, passenger/service lift, manual/hydraulic jib crane, electric hoist block, manual chain block, ladders, fall arrest system, safety harness anchorage points, escape/rescue equipment, runway track, lifting point, fire safety equipment, personal protective equipment and first aid equipment.
b. **End-of-Warranty:** The wind farm owners require end-of-warranty inspections to be carried out to assess the condition of their wind farm prior to the termination of warranty contract with the WTG supplier/wind farm operator or in conjunction with extended-service contract negotiations. A typical end-of-warranty contract involves visual inspections of WTG components and further specialized checks such as full rotor blade inspection, drive-train vibration analysis, gearbox videoscope inspection, oil and grease analysis, SCADA data analysis, operational record analysis, corrosion assessment, arc flash analysis and safety checks.
c. **In-Service:** In-service inspections are carried out either at the discretion of wind farm owners or under operations and maintenance contract agreement or in accordance with the project certification requirements. In-service inspections involve period checks on operation and maintenance records, safety procedures and WTG components. In the following section we provide further explanation on the nature of those inspections.
d. **Incidents:** Inspections involving failure investigation and root-cause failure analysis are carried out following accidents or component failure in wind farms. A typical failure investigation and root-cause failure analysis involves operation and maintenance document review, on-site inspections, mechanical testing, laboratory tests and analyses, data analysis, and forensic investigation in the case of catastrophic failures.

Unless there is a risk-based inspection program in place, which is not very common in wind energy sector, a number of inspections, which are addressed in this section, are conducted periodically. While statutory inspections are carried out in accordance with the applicable legislation of a given country, the frequency and extend of the inspections vary depending on the requirements of wind farm owners. On the other hand it is not uncommon practice to inspect at least 20% of the number of WTGs in a wind farm particularly for offshore wind farms under project certification requirements; as after receiving project certification it is compulsory to get a number of wind farms inspected in order to retain the certified status of an offshore wind farm.

Regular in-service inspections are carried out in accordance with the conditions mentioned in documents such as the WTG operation and maintenance manual. While some wind farm owners have their own in-house inspection teams, most of the in-service inspections are normally carried out by third party companies mainly for two reasons; one being cost effective way of getting wind farm components inspected and the other one is to ensure unbiased inspections.

The objective of statutory inspections is to ensure that all devices, which are subject to statutory inspections, are fit for purpose and safe to use. Likewise the objective of in-service or end-of-warranty inspections is to establish the condition of the turbine components and systems, the safety devices, and the structural integrity of the entire wind turbine in order to ascertain whether the warranty conditions are met and the likely consequences on the future operation of the wind turbine. Whereas the main objective of failure investigation and root-cause failure analysis is to establish the underlying reason for any failure whether it is mechanical, electrical, structural, and behavioral; which may result in operational interruption, environmental or occupational accident.

In the following section we address inspections, reviews, audits and evaluations that are currently performed as part of in-service inspections, end-of-warranty inspections, statutory inspections or failure investigations on offshore wind farms.

2.7.1. Documentation of WTG

At a minimum the following documentations ae reviewed as part of the inspection, audits and evaluations:

a. approval and/or certification reports
b. building permit
c. operating manual
d. commissioning record
e. maintenance checklist (maintenance records)
f. Inspection papers for hoist
g. reports of previous periodic monitoring or condition inspections
h. prior oil analyses
i. documentation of modifications/repairs of the turbine and necessary approvals
j. warranty agreement
k. certificate of conformance

Those documents are checked with regards to:

a. completeness
b. compliance with requirements/ obligations
c. execution
d. performance of periodic maintenance

2.7.2. Essential Inspection Scope

2.7.2.1. Rotor Blades

The visual inspections are carried out to determine the condition of each rotor blade by checking for deformities and damages. The most cost effective way of carrying these inspections is by using binoculars. However this inspection method may not be the most reliable way to assess the actual condition of rotor blades. Hence it has become very common to carry out the rotors blade inspections via rope access (see Figure 1), which has major safety implications unless performed in accordance with rope access safety requirements. A typical rotor blade inspection involves visual checks for cracks, blowholes, delamination, drainage, protective film and erosion at the leading edge, lightning protection system and spark gap, as much as possible. If a major defect is detected, then the use of ultrasonic test (UT) is performed on rotor blades. UT enables inspectors to detect major defects such as delamination, gel-coat disbond, porosity all of which may cause major structural disintegration in rotor blades. During the inspections, inspectors record any serious defect or damage by taking photos or saving UT inspection readings in the UT equipment. The rotor blade inspection team size and composition is normally between 2 or 3 inspectors when rope access technique is used. It is actually requirement of IRATA that there should be a minimum of two rope access technicians per team, who should be capable of carrying out their own rescue[53].

Figure 1 – Rotor Blade Inspection via Rope Access

[53] IRATA (International Rope Access Trade Association, The Application of Rope Access Methods in the Construction, Inspection, Repair and Maintenance of Wind Turbines, UK, 2011

2.7.2.2. Drivetrain

Different techniques are used to carry out inspection listed in the Table 4 – WTG Drive Train Inspections below. One of those techniques is vibration measurement, which is commonly used, by installing sensors (using magnets or glue) on the main bearing, gearbox, and generator. Measurements are taken while the turbine is in operation in order to detect potential failures on bearings and toothing. Furthermore, the vibration measurement enables to pin-point the defect or damage on the specific component, and to detect a misalignment of the drive train between the generator and gearbox.

Assembly	Inspections
a. Hub, axle journal and drive shaft	i. Cracks, corrosion, paint ii. Tightness of clamping set
b. Driven shaft	Leaks, noise, wear, clearance
c. Bolted joint shaft – hub	Corrosion, crack, mounting torque
d. Locking device (rotor)	Function
e. Rotor bearing	Noise, leaks, grease, sump pan, lightning protection system, shaft nut
f. Gearbox	Noise, visual inspection through inspection port, wear of gear teeth, chips, scuffing, micro pitting, contact pattern position, head assembly (spur gears, planetary stages), deposits, leaks, oil quality and specification, oil and filter change
g. Oil Supply	Condition, function and cooling properties. Visual oil level check, condition, frothing formation, mud, accumulation, strainer fouling, oil pump function, noise of heat exchanger.
h. Coupling and brake	Visual function control, alignment and abrasion in outage and in service
i. Hydraulic rotating unit	Leaks, condition, support
j. Torque converter bearing	Condition of rubber elements, movement, mounting position
k. Generator	i. Check for cracks, corrosion, air gap, bolts, insulation ii. Bearing noises, fastening at machine footing, grounding, junction box, brushes

Assembly	Inspections
	and carbonaceous abrasion, vibration, alignment
l. Cooling system	Leaks, damages and connections
m. Safety devices, covers	Condition and function

Table 4 – WTG Drive Train Inspections

Bore-scope is another technique to carry out WTG drivetrain inspections, which has been used for determining gearbox problems in the wind energy industry. As stated by Andrew Engle[54], its biggest advantage is being able to capture pictures, which offer indisputable evidence of damage. However, these visual inspections are not cheap. Typically, if a full visual inspection of a gearbox is performed it will take around 6 to 8 hours to complete this process. Since two technicians are required to carry out inspections for safety reasons, this equals 12 to 16 man-hours. On the other hand, teams that gather vibration data need about two hours to complete their work, equaling a total of 4 man-hours. This option saves money and allows the vibration team to gather data from multiple WTGs in a day. With vibration analysis, all gear teeth and bearings can be examined since it records the frequencies generated by all moving contact surfaces. This allows a more thorough inspection in about 30 percent of the time.

The camera used with bore-scope inspections has limited access to certain components. Depending on the gearbox type, a bore-scope camera can generally only access around 90 percent of the gear teeth and only 30–40 percent of the bearing races and rollers. There are multiple reasons why gearbox bearings are difficult or not possible to inspect. Some of these reasons include:

a. An oil dam plate could be installed in front of the bearing,
b. The bearing's cage is too close to the bearing race to allow camera access,
c. The bearing rollers are small and too close together for the camera to fit in-between,
d. The bearing is completely sealed off,
e. Large gears sit in front of the bearing, making it difficult to access.

2.7.2.3. Nacelle Cover and Force & Torque Transmitted Components

Nacelle cover and force and torque transmitted component are inspected damages, wear, corrosion, leaks, functionality etc. as shown in Table 5 below.

[54] Selecting the Right Drivetrain Inspection Technology, Andrew Engle, Wind Systems Magazine, Jan 2015, http://www.windsystemsmag.com/article/detail/620/selecting-the-right-drivetrain-inspection-technology

Assembly	Inspections
a. Nacelle cover, main frame	Condition, corrosion, damages
b. Yaw drive/motors	– Function, damages, wear
c. Yaw bearing	– Lubrication, noise, corrosion, leaks
d. Yaw toothing	– Tooth chippings, lubrication, contact pattern, wear
e. Yaw brake	– Leaks, wear
f. Locking device (yaw system)	– Function
g. Yaw plate	– Condition, corrosion, damages, function
h. Crane	– Condition, corrosion, damages, function
i. Opening mechanism	– Condition. Corrosion, damages, function
j. Anchor and lifting points	– Condition. Corrosion, damages, function

Table 5 – Nacelle Cover, Force & Torque Transmitted Component Inspections

2.7.2.4. Hydraulic and Pneumatic System

Hydraulic and pneumatic systems of WTG, regardless of the type of technology and energy used, are inspected as shown in Table 6 below.

Assembly	Inspections
a. Pump	Noises, leaks, shut down delay, temperature, time for pressure build-up
b. Accumulator	Year of manufacture, residual pressure, arrangement
c. Hoses and connections	Cracks, leaks, routing, rubbing, chafe marks
d. Oil reservoir	Volume, oil level
e. Rotating union	Condition, function

Table 6 – Hydraulic and Pneumatic Inspections

2.7.2.5. Tower and Foundations

Tower and foundations are inspected for structural integrity as shown in Table 7 below.

Assembly	Inspections
a. Foundation	General condition, concrete integrity, damages, cracks, corrosion, sealing joint, water drain
b. Grounding devices	Connection, corrosion
c. Tower incl. doors	Corrosion, cracks, ladder, bolted joints, paint
d. Tower installed equipment	Ladder assembly, visual inspection and function of fall protection, safety plates, anchor and lifting points, platforms and railing
e. Sealing	Internal and external grouting
f. Repairs	Integrity of repairs
g. Lightning protection	Visual inspection

Table 7 – Tower and Foundation Inspections

2.7.2.6. Safety and Brake System

Safety and brake system of WTG are inspected for compliance, functionality, wear, damages etc.as shown in Table 8 below.

Assembly	Inspections
a. Safety device	Function, compliance of limits, damages, wear
b. Mechanical brake	i. Calliper and pads: wear, air gap, springs, corrosion, pressure, leaks ii. Disc: profile, color, true running iii. Function, activation time
c. Over-speed limit, emergency button, short circuit control	Function
d. High speed locking devices	Function, compliance of limits, damages, wear
e. Cable twist sensor	Function, damages, wear

Assembly	Inspections
f. Res-Q system	Function, compliance, damages, wear
g. Fire extinguishers	Compliance, damages, wear

Table 8 –Safety and Break System Inspections

2.7.2.7. *Control System and Electrical*

Control system and electrical components are inspected for functionality, wear, damages, corrosion, connections etc. as shown in Table 9 below.

Assembly	Inspections
a. Wind vane and anemometer	Visual inspection, function
b. Control cabinets	Structure, damages, corrosion, paintwork, electric shock protection, grounding, ventilation, attachment, cable routing, chafe marks, arcing evidence, leeks, drainage.
c. Control system	Function, plausibility, limit values, error messages
d. Cable harness	Cracks, damages, connections
e. Transformer station / medium voltage cabinet	i. Station is protected against intrusion of water, animals and plants ii. Lock and safety plates iii. Personal safety equipment iv. Information plates v. Transformer attachment, presence of circuit diagram of transformer station
f. Cabling	Damages, corrosion, wear, twisting, chaff marks, attachment arcing evidence
g. Emergency lighting	Function, damages, corrosion

Table 9 – Control System and Electrical Component Inspections

2.7.2.8. *Analysis of the Lightning Protection System*

The inspections and measurements on the functionality of the lightening protection system are carried out according to the relevant standards and requirements. The measurements typically include the lightening conductor from the hub and drive train, the tower, to the foundation and into the ground.

2.7.3. Condition Monitoring

2.7.3.1. General

Condition monitoring is an integral part of the in-service or end-of-warranty inspections of WTGs. It is used to determine the technical status of the wind turbine, to detect and specify embryonic damage and to help to avoid secondary damages by early detection of faults. In practice, as it becomes necessary to get more sophisticated information, the condition monitoring inspection scope usually gets extended by specific techniques such as vibration measurement of the drivetrain in combination with oil analysis of the generator bearings and video endoscope inspection of the gearbox.

2.7.3.2. Premises of Inspection

Inspection companies normally require access to the following for the condition monitoring inspections:

a. appropriate access to WTG
b. service manual
c. maintenance records and oil inspections
d. operating manual
e. building permission, type approval or individual approval documents
f. declaration of conformity
g. installation and assembling records
h. records of commissioning
i. reports of previous inspections
j. the kinematics data of the drive train

Inspection companies check those documents for:

a. completeness
b. compliance with requirements/ obligations
c. execution
d. performance of periodic maintenance

2.7.3.3. Scope of Condition Based Monitoring

The main objective of this inspection is to ascertain the condition of drivetrain. A typical inspection report includes results from the visual check, vibration measurement, video endoscope inspection, and oil/grease analyses. When irregularities and initial damages are identified, the inspectors normally assess the condition of the concerned parts in relation to the designed life and make recommendations for maintenance practices and frequencies in accordance with corrective maintenance approach.

2.7.4. Typical Inspections for Asset Valuation

It is generally observed that when a wind farm is subject to acquisition, or insurance renewal, the interested parties or underwriters require further detailed inspections to be carried out in order to determine the safety and operational fitness of a wind farm. Those inpections normally include:

a. Rotor blade inspections
b. Video endescope inspections
c. Vibration analysis
d. Oil analysis
e. Thermographic investigation of electrical components
f. Additional investigations/analyses

2.7.4.1. Rotor Blade Inspection via Rope Access

Rotor blades one of the WTG components that are subject to major wear and tear and structural damages as they are highly exposed to environmental conditions. The rope access techniqie is commonly used for rotor blades inspections for ofsshore wind farms. These inspections cover the elements listed in Table 10 below:

Assembly	Inspections
a. Blade body	Visual control regarding cracks, blowholes, delamination, drainage, protective film and erosion at the leading edge, lightning protection system and spark gap i. Flow elements, like Turborills, Vortexgenerators, Stallstripes and Gurney Flaps (where applicable) ii. If technically possible, the blade will be checked from inside (this should be possible for approximately 1/3 of the length of the blade)
b. Blade sealing to hub	Oil in the blade, lightning protection system on blade
c. Extender	Corrosion, bolting, weld seams
d. Blade adjusting device	i. Bearings, greasing, mechanism allowance, leakages, tooth bearing, torque rod, oil in the blade ii. Locking device and fixing of cabinets iii. Attachment of cabinets
e. Cable twist protection	Function
f. Spinner support	Condition, corrosion, damages, function

Assembly	Inspections
bracket and structure	

Table 10 –Rotor Blade Inspections

2.7.4.2. Video Endoscope Inspection

The most common technique for detailed gearbox inspection is the internal video endoscope technique. Video endoscope inspections of the accessible gearbox toothing and bearings are normally carried out either in parallel to vibration measurement or as a result of vibration measurement or oil analysis findings. Video endoscopy allows damaged gearbox parts to be visually inspected to obtain a clear portrait of their exact condition; therefore it is highly beneficial in determining the structural integrity of a gearbox, which directly affects the performance and operational safety of a drivetrain.

2.7.4.3. Vibration Analysis

For the vibration measurement solid borne sound sensors are applied (there are attached to the surface with magnets or glue) on the drive train components namely main bearing, gearbox and generator. Unlike in other WTG inspection routines where the WTG must be shut-down to ensure safe inspections, in this particular inspection method the wind turbine must run at a minimum of 10% - 20% of the rated power during vibration measurement in order to get meaningful results. This measurement takes up to five minutes.

Following the vibration measurements, collected data is analyzed to detect possible failure frequencies of bearings and toothing by a vibration specialist. Data gather in this measurements enable vibration data analyst to detect failures at bearings and toothing and also determine misalignment between generator and gearbox in the drive train. Including the following minimum data, the kinematic data of drive train’s components and WTGs are required for a complete vibration measurement analysis:

a. Main bearing: type, designation and manufacturer,
b. Gearbox and gear bearings: type, designation, manufacturer, design, meshing frequency of all the gearwheels and pinions,
c. Generator and generator bearings: type, designation, manufacturer.

If the kinematic data is not available for the analysis, the video endoscope inspection of the gearbox can compensate for the missing information partly and assist in providing a statement regarding the gearbox conditions.

The analysis of the main bearing and generator is possible without having the kinematic data but in this case a higher degree of uncertainty tends to persist in relation to the results and recommendations. Therefore analysis of the gearbox oil is normally recommended as an additional analysis to complete the gearbox inspection depending on the results of the vibration analysis.

2.7.4.4. Oil Analysis

For WTG gearbox, wear debris particle analysis is a strong tool to predict mechanical failures. The technique isolates wear particles from machinery and classify the debris by microscope combined with chemical analyses. Testing of used oil is a preventative maintenance tool that operates as an early warning system. By utilizing this method it is possible to detect failures at the planetary stage of the gearbox. This analysis compensate for the weakness in the vibration measurement, which cannot reliably detect damages at the planetary stage because of overlapping frequencies of several parts. An investigation of shape, surface, size and colors can identify the alloy and the number of particles to determine if wear is severe. By this examination, it is possible to identify if particles come from cutting wear, severe sliding or fatigue. Their origin might also be from ingress from the surroundings like sand or dust. The oil analyses include the following checks:

a. appearance
b. particle counting – SAE 4059/ISO 4406-99
c. water by Karl Fisher titration
d. viscosity at 40°C ASTM D445
e. viscosity at 100°C ASTM D445
f. viscosity index
g. Total Acid Number (TAN) – ASTM D 664
h. Metals by ICP ASTM D5185
i. WPI (Wear Particle Index)

Once the oil analyses results are obtained, a report with recommendations is prepared on the condition of the gearbox.

1.1.1.1. Thermographic Investigation of Electrical Components

Thermographic investigations are conducted on the following systems WTGs.

a. Main breaker
b. Cooling systems (to check for blockages resulting in hot spots)
c. Air bushing connections
d. Transformer tank (with emphasis on the gasket areas)

2.7.5. Damage and Failure Investigation / Analysis

The following steps are typically taken for a thorough damage investigation as part of root-cause analysis following a component failure or accident resulting in operational failure, injury or fatality in an offshore wind farm.

a. Inspection of the damaged wind turbine / component

b. Documenting of the condition of the inspected wind turbine / OSP /MetMast component

c. Investigation on the root cause for the damage

d. Issuing an damage investigation report

2.7.6. Statutory Inspections

As we stated earlier, the statutory inspections requirements vary from country to country, but typical statutory inspections for wind farms include the pressure systems, lifts, anchor points, davit crane and other cranes in WTGs, OPSs and MetMasts. Specifically the components that are subject to statutory inspections are as following:

a. Hydraulic Accumulators
b. Lifting Equipment
   i. Passenger/Service Lifts
   ii. Lifting Points/Beams
   iii. Electric Hoist Block/Tool hoist
   iv. Manual/Hydraulic Jib Crane
   v. Manual Chain Block
   vi. Safety Harness Anchorage Points
c. Fire Extinguishers/Fire Safety Equipment
d. Ladders/Runway track
e. Personal Protective Equipment
   i. Escape/Rescue Equipment
   ii. Fall Arrest System
f. First Aid Equipment

2.7.7. MetMast Inspections

As integral part of offshore wind farm MetMast also require regular inspections. We addressed the safety related inspection requirements within the statutory inspection above. While some MetMast owners engage companies to conduct regular inspections via conventional inspection methods, some others resort to new technology to facilitate inspections in recent years. In 2014, Forewind, which is a joint venture between RWE, SSE, Statoil and Statkraft, used a company to conduct MetMast inspections via a remote-controlled drone with four helicopter-like rotors, weighing no more than two kilograms and equipped with a camera to inspect Forewind's meteorological masts located more than 130 kilometers from the UK coast.

The innovative inspection technique is adopted from the oil and gas sector where remotely operated aerial vehicles (ROAV), as they are known in the industry, are employed to assess offshore components that are difficult or risky to access.

Operated by a two-man crew sitting safely on a nearby vessel, the ROAV was flown to the Forewind meteorological masts (see Figure 2) by a dedicated 'pilot' while an inspection engineer controlled the camera and took photos and video of the lattice towers and platforms of both Dogger Bank MetMasts.

Figure 2 – MetMast Inspection with Drone[55]

Following the data collection, the high-definition images were then assessed to inspect the structure of the lattice tower, evaluate the bolt connections and review the overall state of the masts. The information was used to prepare for a scheduled maintenance trip. Forewind Operations and Safety Manager said the inspection technique reduced the health and safety risks associated with transferring to the platform from a vessel, or climbing up the towers to work at height.

This inspection technique can be used more widely across the offshore wind industry to make efficiency gains and reduce health and safety risks during operation and maintenance phase of offshore wind farms.

2.7.8. OSP, Subsea Cable Inspections

OSP components are inspected in accordance with applicable standards and regulation, component manufacturers' operations and maintenance manuals. Inspection companies normally require access to the following for the inspections:

a. appropriate access to OSP
b. service manual
c. maintenance records

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[55] http://www.forewind.co.uk/news/104/34/Remote-controlled-drone-inspects-met-mast.html

d. operating manual
e. declaration of conformity
f. installation and assembling records
g. records of commissioning
h. reports of previous inspections

Inspection companies check those documents for:

a. completeness
b. compliance with requirements/ obligations
c. execution
d. performance of periodic maintenance

Inspections are carried out on the following aspects of the OSP:

a. Functionality of equipment (damage, wear and tear)
b. Structural integrity of top side and substructure(corrosion, cracks)
c. Transformer, electrical equipment and cables
d. Fire and explosion protection system
e. Maintenance of access, escape and evacuation routes
f. Crew transfer safety (by boat and helicopter)
g. Safety and warning signage
h. Insulating matting and/or platforms
i. Lifesaving or intervention kits (portable or wall mounted)

g. Voltage detectors
h. Earthing kits

Subsea cables also get inspected periodically particularly in offshore zones that have extensive marine traffic, which increases subsea cable damage risk due to accidental anchoring, and also in areas that have dynamic environments such as shifting sands[56] where subsea cables get exposed and covered again with the moments of sand, and even in the hard-bottom areas which may cause damage to subsea cables over time.

Subsea cable inspections require monitoring of cable burial depth over time, which is normally tracked alongside the cable electrical testing properties and general site seabed movement monitoring. Subsea cable inspections also include checks on the cable ends as they enter the j-tube or foundations.

Typical subsea cable inspections consist of acoustic surveys and ROV inspections for condition monitoring including cable depth of burial. For subsea cable inspections, sensors are used to determine the horizontal position and condition of the cable, so that they are accurately mapped and recorded.

[56] This phenomena is commonly observed in the Scroby Sands Offshore Wind Farm, which is located on the Scroby Sands sandbank in the North Sea, 2.5 kilometres (1.6 mi) off the coast of Great Yarmouth in eastern England, United Kingdom.

Multi-beam echo sounders are used to provide a complete overview of a wind farm site, both in terms of water depths and seabed morphology when used in conjunction with previous datasets. Side scan sonar data collected during survey operations are used to identify cable exposures, freespans and contacts occurring within the boundaries of the surveyed areas, in addition to providing information on seabed material types and sedimentary features.

Subsea cable inspections are carried out by using free-flying and tracked ROVs equipped with dedicated cable trackers to accurately determine the relative depth of burial for cables. All systems are mobilised with internationally recognized TSS cable trackers, for both active and redundant cables, which provides accurate and reliable information on the vertical position of cables.

2.7.9. Reporting

Following an inspection, audit, evaluation or investigation, the inspector prepares a report for each WTG or OPS component. It is also common to see a summary inspection report prepared for the entire wind farm when inspections are carried out as part of end-of-warranty or technical due diligence process. A typical inspection report includes the following:

a. The report, which includes photos, measurements, data and analytic assessment, where applicable, elaborating on inspection results, status and conditions of the inspected components. A typical inspection highlights the technical assessment results, compliance issues and ranks these into major and minor ones with relevant comments.
b. Report also includes results of any measurements, which may be taken during the inspections, in a form of attachment.
c. The report is completed with recommendations for corrective actions and preventative maintenance practices for reliable and safe operations.

2.8. Current Offshore Electrical Service Platforms Inspections, Audits & Evaluation Practices

In this section we address what inspections, audits, and evaluations are currently performed and/or required on offshore substations/offshore electrical service platforms.

As OWFs have grown larger and further from shore, offshore substations have become a necessary addition to the system design. However there are still very few regulations, standards, and guidelines to provide a framework for the design, installation, and long term management of these installations.

2.8.1. DNV-OS-J201

In 2014 Det Norske Veritas (DNV) (now part of Det Norske Veritas and Germanischer Lloyd [DNVGL]) published the *Offshore Standard DNV-OS-J201 Offshore Substations for Wind Turbines*. A summary of the requirements of this standard are given in the following paragraphs:

General Requirements for the Offshore Substation:

a. Meet functional and operational requirements
b. Reduce the effects of hazards
c. Separate areas of different hazard and/or danger level
d. Prevent escalation of hazardous events
e. Minimize the consequences of fire and explosion as low as reasonably practicable (ALARP)
f. Facilitate escape and evacuation
g. Meet additional requirements due to its function as an offshore structure

Objectives of construction design:

a. Outline a realistic project program with adequate time for planning and execution
b. Early identification and reduction of risks
c. Minimize work required offshore by completing work onshore including (partial) commissioning and testing
d. Facilitate co-operation between parties involved in construction

A risk based construction design shall be adopted in the design process considering safety, environmental consequences and total life cycle costs.

2.8.1.1. Installation Inspections

Warranty Survey during the sea transport and installation are recommended to satisfy insurance and owner requirements.

2.8.1.2. Operating Inspections

Operating Inspections are recommended covering the entire installation including:

a. Accessibility for inspection and maintenance
b. Test of emergency response systems

The Operating Inspections are required to be defined based on:

a. Applicable codes and standards
b. Manufacturer required inspection and maintenance scope and frequency
c. Design lifetime of structure, systems and components
d. Site conditions, see Sec. 4 [2.3]
e. Deterioration processes
f. Knowledge based on design and technology
g. Experience gained from similar installations; historical inspection and maintenance data
h. Access and transfer options, see Sec. 7

The DNV guide also allows for development of a risk-based inspection program.

The inspections should include

a. Visual inspection
b. Non-destructive testing

c. Instrumentation and condition monitoring
d. Corrective maintenance

2.8.1.3. Structural Components above Water

a. Dents and deformation
b. Fatigue cracks
c. Bolt pretension
d. Corrosion
e. Marine growth
f. Foundation structure
g. Platform decks, walls and appurtenances
h. Walkways, stairs, ladders
i. J-tubes, fenders, pipework
j. Lifting appliances
k. Helicopter deck
l. Main and auxiliary transformer(s)
m. Emergency Pushbuttons and Shut Down Systems
n. High and medium voltage switchgear
o. Emergency power generation equipment (diesel generator, batteries, Uninterruptible Power Supply [UPS])
p. Auxiliary power supply, heating, ventilation, and air conditioning (HVAC) equipment and similar facilities
q. Cables
r. Earthing
s. Measurement, monitoring, control (parameters and settings) and protection systems.
t. Cable terminations
u. Cable burial to design depth shall be verified

2.8.1.4. Fire protection systems

In accordance with national and local regulations.

2.8.1.5. Helidecks

a. Helicopter deck free from oil, grease, snow, ice, surface water and other contaminants
b. Landing net
c. Perimeter safety netting
d. Tie-down points
e. Wind indicator
f. Perimeter and flood lighting
g. Fuel system installation and earthing

2.8.1.6. Safety and Emergency Response System

a. Emergency lighting
b. Communication systems

c. Rescue equipment
d. Fall arrest systems
e. Personal safety and protection equipment
f. Markings, warnings, and identification panels

2.8.2. DNV-OS-D201

In 2011 DNV (now part of DNVGL) published the *Offshore Standard DNV-OS-D201 Electrical Installations*. Some of the requirements of this Offshore Standard can also be applied to Offshore Substations in Wind Farms. A summary of the requirements of this standard are given in the following paragraphs:

2.8.2.1. Switchgear

Factory Testing

a. Documentation
b. Function test: all basic functions, including auxiliary functions, shall be tested
c. Insulation resistance test
d. High voltage test
e. Visual inspection of switchboards and assemblies creepage and clearance distances, Ingress Protection (IP) rating, ventilation and quality of materials and components
f. Function testing of circuits per as built document
g. Control and protection shall be tested for correct functioning

Onboard testing

a. Complete function
b. Power frequency
c. Insulation resistance tests
d. Voltage test between the circuits and between live parts and the enclosure
e. Insulation resistance
f. Power frequency test for high voltage assemblies

2.8.2.2. Rotating Machines

Factory Test

a. Documentation
b. Air gap
c. Visual
d. Enclosure
e. Overspeed
f. Withstand voltage
g. Winding resistance
h. Temp rise
i. Insulation resistance
j. No-load and overload current

k. Short circuit

Onboard test

a. Full load starting and running

2.8.2.3. Transformers

Factory test

a. Type Test (TT) and Routine Tests (RT), documented, RT ref TT
b. Enclosure
c. Insulation resistance
d. Terminations
e. Winding resistance
f. No load voltage
g. Short circuit impedance
h. No load loss
i. Withstand voltage
j. Temp rise
k. Partial discharge

2.8.2.4. Converters

Factory Test

a. TT and RT, documented, RT ref TT
b. Documentation
c. Visual
d. Function
e. Input voltage and frequency tolerance
f. Stored energy
g. Insulation test high voltage
h. Insulation resistance
i. Rated current full load test
j. Temp rise
k. Control and monitoring
l. Short circuit
m. Capacitor discharge
n. Coolant Pressure test
o. Cooling failure test
p. Fault tests

Onboard tests

a. Complete function test in all load conditions

2.8.2.5. Cables

Factory Tests

a. RT and Product Sample Tests (PSTs)
b. Physical properties
c. Electrical resistance
d. Voltage test
e. Insulation resistance
f. Insulation properties
g. Heat resistance

Onboard Tests (installation/commissioning)

a. Installed per design documentation
b. No hazard to life
c. No fire hazard
d. Function as required for safe and correct operation
e. Ventilation
f. Ingress and egress
g. Escape routes
h. Earthing
i. Voltage withstand test of installed cables
j. Insulation resistance test of installed cables
k. Frequency test at full load
l. Functional test of all critical equipment
m. Protective functions
n. Alarms and indicators
o. All control modes
p. Full load test of system to stable temperature rise
q. Voltage drop measurement
r. Battery function
s. Harmonic measurement

2.9. Current Offshore Electrical Transmission Cables Inspections, Audits & Evaluation Practices

In this section we address what inspections, audits, and evaluations are currently performed and/or required on electrical transmission cables, particularly subsea transmission cables.

Several general guidelines and standards exist for subsea power cables, such as Institute *of Electrical and Electronics Engineers (IEEE) Guide for the Planning, Design, Installation, and Repair of Submarine Power Cable Systems*.

In addition, in 2014 DNV (now part of DNVGL) published a recommended practice specifically for subsea cables connected to OWFs, *Recommended Practice DNV-RP-J301 Subsea Power Cables in Shallow Water Renewable Energy Applications*. Excerpts from this document follow:

2.9.1. DNV-RP-J301

Manufacturing inspections

a. Correct identification, documentation and use of materials
b. Qualification and acceptance of manufacturing procedures and personnel
c. Inspection of preparatory work
d. Inspection of manufacturing work for compliance with specifications and procedures
e. Witnessing of testing
f. Inspection of repairs
g. Examination of testing equipment and/or measuring/recording devices vital for correct functioning of equipment and machinery used in manufacturing.

The as-built survey should include the following, as applicable:

a. Position of the cable, also with regard to permitted tolerances of the cable route
b. Depth of lowering and/or depth of cover, as applicable, if not ascertained during burial operations
c. Location of any areas with observed scour or erosion along cable route
d. Identification and quantification of any free spans with length and gap height
e. Description of previously unidentified wreckage, debris or other objects which may affect the cable system, if applicable
f. Location of damage to cable (if applicable)
g. Video documentation of the subsea cable system interfaces at offshore units, if applicable and required

2.9.1.1. Testing

Before a cable system is considered ready for operation or put into service, it should be visually inspected and tested. Inspection and testing activities may include the following:

a. Visual inspection: May include routing and fixing in offshore units and termination (mechanical, electrical) of the cable in accordance with the specification. This also applies after modifications and alterations.
b. Non-electrical tests: May include an Optical Time Domain Reflectometer (OTDR) test after installation, provided that the power cable contains optical fibres or is bundled with a fibre optic cable. The number of fibres to be tested should be agreed.
c. Electrical tests: Should include a high voltage test after termination.

The combination of tests to use for a particular subsea cable system should be specified and the responsible parties should be agreed.

2.9.1.2. Asset management system

The cable owner/operator shall establish and maintain an asset management system which complies with regulatory requirements.

2.9.1.3. Monitoring and inspection

A list of potential cable tests during the operational phase are provided in Table 11 below.

Table 7-1 Potential cable tests during the operational phase

Method	*Requirements*	*Online / offline*	*Cable parameters monitored*	*Limitations*	*Recommendation*
Power flow measurement	Voltage / current transformers at cable end(s), SCADA system	online	Electrical power, (estimated temperature rise)	Point measurement(s)	High
Distributed temperature sensing (DTS)	Optical fibre inside / at / near cable, measurement system at one/ both cable end(s)	online	Temperature 1), current rating through real-time thermal rating, inference of degree of burial protection	Several tens of kilometres, resolution better than 2-3 m and ± 1 K 2)	Medium 3)
Distributed strain sensing (DSS)	(Special) optical fibre inside / at / near cable, measurement system at one cable end	online	Mechanical stress on cable, e.g. free spans	Several tens of kilometres, no established track record	Low
Partial discharge (PD) monitoring	Permanent or temporary measurement system, 'low noise' environment	online / offline	Insulation performance	Up to several kilometres, limited use at HV (except terminations), no established track record in this application	Low
Sheath integrity check	Non-conducting cable sheath material, disconnectable earthing, temporary measurement system	offline	Water ingress, insulation performance	Outage and access for measurement required	Low

1) Temperatures differ at the various construction elements within a power cable. Sensing by optical fibres within or near the power cable are indirect measurements of the conductor temperature. Calibration and modelling are required to establish the relationship between optical measurement and power cable core temperature.

2) Better resolution can be achieved for shorter lengths.

3) Commonly used in export cables.

Table 11 – Potential Cable Tests during the Operational Phase

2.9.1.4. Periodic testing

a. *Cable and cable environment temperature*

b. Partial discharge

c. *Cable sheath leakage currents*

2.9.1.5. Periodic inspections

A cable verification survey is a survey to determine the position and condition of the cable system and its components. Data from the as-built survey ([6.8]) can normally be used; otherwise, specific inspections should be completed within one year from start of operations. In case of significant changes after this first inspection, the need of additional inspections should be determined.

A detailed external inspection plan including specifications for the inspections shall be prepared for each survey. The detailed inspection plan should be updated based on previous inspections as required. External inspection shall be carried out to ensure the design requirements remain fulfilled and that no damage has occurred. The inspection program should, as a minimum, address by means of general inspection under water:

a. Exposure and burial depth of buried or covered cables, if required by design, regulations or other specific requirements
b. Free spans including mapping of length, height and end-support conditions
c. Condition of artificial supports installed to reduce free span
d. Local seabed scour, settlement, subsidence or instability affecting the cable integrity
e. mega-ripple/sand wave movements affecting the cable integrity
f. Cable settlement in case of exposed sections
g. The integrity of cable protection covers (e.g., mattresses, covers, sand bags, gravel slopes, etc.)
h. Mechanical damage to cable
i. Major debris on, or close to, the cable that may cause damage to the cable
j. Functionality of supports and guides and integrity issues (e.g., cracks in welds)
k. Damage or displacement (e.g.,-due to vessel impact or foundation settlement)
l. Corrosion (e.g., of J- or I-tubes)
m. Damage to coating
n. Extent of marine growth

2.9.1.6. Security surveillance

Depending on the risk profile along the cable route, active security monitoring of specific sections may provide effective mitigation measures that may be considered include the following:

a. Electronic monitoring by means of radar (based on land or offshore unit), by review of vessel monitoring system data (e.g., fishing vessels) or by analysis of Automatic Identification System (AIS) data (e.g., larger vessels)
b. Sea patrol in high-risk areas
c. Terrestrial patrol of land cable section (e.g., during nearby construction activities)

2.9.2. Fault detection and location

2.9.2.1. General

Survey results and operational data of a cable should be reviewed for indications of problems. Measurement systems such as power quality and DTS may provide useful information on the operational history and overload conditions that could cause failure, see [7.3.1].

2.9.2.2. Cable location

The cable route shall be ascertained by the documented and charted as-built information, subsequently confirmed by inspections during the Operation and Maintenance (O&M) phase.

The location of cables may be confirmed by as-built survey methods and/or geophysical methods.

2.9.2.3. Fault location

Except where the fault location is obvious, several methods should be employed to locate a fault in a cable. Often a combination of coarse and fine location methods is advisable. For coarse location of a fault, measurements from both ends of the cable should be performed, where feasible.

2.10. Subsea Structural Components, Scour Protections and Inspections

In this section we address whether subsea structural components and scour protection are inspected.

2.10.1. DNV Guidelines

According to DNV OS J101[57], it is required for structures below water and submerged power cables to be inspected periodically in order to assess and evaluate their condition. General visual underwater inspections can be carried out using an ROV (Remotely Operated Vehicle), whereas close visual underwater inspections require inspections carried out by a diver.

Periodic inspections and monitoring are required to maintain the project certificate for an offshore wind far according to DNV rules. The periodical subsea inspections are to be carried out in accordance with a long-term inspection plan, and the scope should be sufficient to provide evidence whether the structures or structural components continue to comply with design assumptions stated in the Certificate of Compliance issued by the Certifying Authority.

The offshore inspections typically would include tests and inspections on site as well as an assessment of the findings in order to distinguish between random failures and systematic failures.

The interval between inspections of critical items should not exceed one year. For less critical items longer intervals are acceptable. The entire wind farm should be inspected at least once during a five-year period, however DNV OS inspection intervals for subsequent inspections should be modified based on findings.

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[57] Section 13

2.10.2. GL Guidelines

GL Guidelines for the Certification of Offshore Wind Turbines[58] specifies that periodic inspections must be performed on the support structure (tower, substructure, and foundation). Inspections should focus on corrosion, corrosion protection (including cathodic protection), marine growth, any damage, deformation, or spalling of the support structure, cracks and abrasions. Cleaning of the surface may be necessary in order to perform inspections. The location and extent of corrosion control devices and their effectiveness must be assessed.

For areas within the splash zone, a visual inspection can be performed, however, if damage is found further down, then diver inspections are recommended. For areas where excessive corrosion is evident, plate thickness measurements may be required.

In addition to the above, GL guidelines require that the scour protection, seabed level and underwater and splash zone structure are to be inspected. GL guidelines outline different schemes for the design of the scour protection system[59], which differ in their inspection requirements. The intervals between inspections are to be defined in the inspection plan by the operator and agreed upon with the Certification Authority.

2.10.3. IEC Guidelines

Regarding subsea inspections, IEC 61400-3 requires the inspection and possible removal of marine growth, as well as maintenance of the scour protection system to be listed in the maintenance manuals for offshore wind turbines. The corrosion protection system shall also be subjected to an inspection program.

2.10.4. ABS Guidelines

The ABS Guide for Building and Classing Bottom Founded Offshore Wind Turbine Installations[60] requires annual surveys of the above water structure. When significant deterioration or damage is evident since the last survey, an examination of the underwater structure either by diver, underwater camera, submersible or other suitable means must be undertaken. This examination is to include the underwater structure, the scour protection, the sea floor, and the corrosion control system. These inspections are to be undertaken by the owner monitored by a surveyor.

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[58] Section 11.1

[59] Section 6.7.7.4

[60] Chapter 1 Section 3

2.10.5. API Guidelines

The API RP-2A - Planning, Designing, and Construction Fixed Offshore Platforms – Working Stress Design[61] is a crucial standard in the offshore oil and gas industry. Chapter 16 is specifically dedicated to inspection of offshore structures. It should be noted though that this standard utilizes the Working Stress Design (WSD) engineering methodology which is common in the oil and gas industry. Offshore wind generally utilizes the Load Resistance Factor Design engineering methodology.

2.11. Inspection Scale

In this section we address whether all turbines in a wind farm are inspected/audited/evaluated or if they are performed on a sample of turbines. Where we find that such sampling occurs, we address what sampling method is used (e.g., randomly, by class).

Inspections shall be carried out at regular intervals on the basis of an agreement between applicant and certification/authorization body and/ or insurance company. The agreement shall specify the interval frequency and the extent of the surveillance. The interval frequency depends on the number of structures in a wind farm and also on the design and the specific environmental conditions.

For single wind turbine structures and for wind farms comprising only a few wind turbine structures, it may be feasible to define rigid inspections programs with requirements to annual inspections and other periodical surveys which cover all turbines and structures in a wind farm. For large numbers of wind turbine structures in large wind farms, such rigid inspections programs will be far too comprehensive to carry out, and inspection programs defined from risk-based inspections planning are recommended. In wind farms with many series manufactures identical or almost identical structures, it suffices to carry out inspections on a few representative structures per year only[62].

For offshore wind farms a long term inspection program has to be prepared, in which all disciplines and systems to be covered by the program are specified. Certification Bodies like ABS[63] or DNV, now known as DNV-GL, recommend continuous inspections applied annually to a minimum of 20% of the Offshore Wind Substructure Installations in the Wind Farm.

In German waters the Bundesamt für Seeschifffahrt und Hydrographie (BSH), the German authorization body for offshore construction, request periodical inspections of the entire system (turbine and support structure) to be performed annually on 25% of the installations of the offshore wind farm, so that all offshore wind turbines will have been inspected after each block of four years. In addition the BSH request that 10% of the offshore wind turbines needs to be monitored by means of a suitable Condition Monitoring System. Central structures such as the transformer substation shall be inspected annually, whilst deviation from the annual inspection is permitted for other individual structures.

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[61] API RP-2A, Chapter 16

[62] Offshore Standard DNV-OS-J101, September 2011

[63] Guide for Building and Classing - Bottom-Founded Offshore Wind Turbine Installations, ABS, 2013, Houston

For onshore wind turbines in Germany the inspection interval is related to the individual license, the type certification and the surveyor's statement. According to the "German Center of Competence in Civil Engineering[64]" the inspection interval shall not exceed 2 years (but there is an opportunity to extend it to 4 years, if the monitoring of the wind turbine is warranted via authorized experts).

We **recommend** BSEE to demand offshore wind farm owners to have continuous inspections applied annually to a minimum of 20% of the Offshore Wind Substructure Installations in the Wind Farm combined with a condition monitoring program where in minimum 10% of the offshore wind turbines are equipped with suitable CMS.

2.12. Documentation of Results of Inspections, Audits and Evaluations

In this section we address how the results of inspections/audits/evaluations are recorded and how deficiencies are addressed.

The inspection, audit or evaluation report shall be written and signed by the technical expert – who actually carried out the inspection, audit or evaluation. The report shall contain the following information at least:

- Manufacturer, type and serial numbers of the wind turbine or component in question (e.g. tower, foundation, gearbox, rotor blade, etc.)
- Location (site) and operator of the wind turbine or name and address of the manufacturer site
- List of documents (incl. name, document number, revision, etc.) which were reviewed for/ during the inspection
- Date of erection, commissioning, last service/ maintenance and inspection
- Operating hours and total energy produced
- Date, time and climate conditions (e.g. weather, sea conditions) on the day(s) of inspection
- Persons (name, function) present at the inspection
- Detailed description of the inspection scope incl. any references
- Reason and aim of the inspection
- Remarks and damage/ deficiencies found, if possible photos are to be taken and used to describe the findings in more details
- Result and recommendation of the inspection

The results, the deficiencies found and the necessary conditions and restrictions shall be stated on the first page of the report.

The report shall also prescribe a timeframe for competent repair or further investigation and state a date for the next inspection.

[64] "Richtlinie für Windenergieanlagen - Einwirkungen und Standsicherheitsnachweise für Turm und Gründung" of the "German Center of Competence in Civil Engineering", https://www.dibt.de/en/DIBt/DIBt.html

The following federal code refers to the inspection activities that BOEM is responsible for, but this responsibility is now under the scope of BSEE.

30 CFR 585 – Renewable energy and alternate uses of existing facilities on the OCS

Subpart H – Environmental and Safety Management, Inspections, and Facility Assessments for Activities Conducted Under SAPs, COPs and GAPs

§ 585.833 What are the reporting requirements for incidents requiring written notification?

a) For any incident covered under § 585.831, you must submit a written report to BOEM within 15 days after the incident. The report must contain the following information:
    i. Date and time of occurrence;
    ii. Identification and contact information for each lessee, grant holder, or operator;
    iii. Name and telephone number of the contractor and the contractor's representative, if a contractor is involved in the incident or injury;
    iv. Lease number, OCS area, and block;
    v. Platform/facility name and number, or cable or pipeline segment number;
    vi. Type of incident or injury;
    vii. Activity at time of incident;
    viii. Description of incident, damage, or injury (including days away from work, restricted work, or job transfer), and any corrective action taken; and
    ix. Property or equipment damage estimate (in U.S. dollars).
b) You may submit a report or form prepared for another agency in lieu of the written report required by paragraph (a) of this section if the report or form contains all required information.
c) BOEM may require you to submit additional information about an incident on a case-by-case basis.

2.13. In-House Inspections, Audits and Evaluations by OWF Operators

In this section we address to what degree regulators or other governing bodies rely on self-inspection, self-audit, self-evaluation or self-certification programs by OWF operators.

European regulators and governing bodies request to have third party inspection, audits, evaluation and certification to receive e.g. building and/ or operating permission.

Self-inspection etc. are accepted for e.g. maintenance/ service inspection of the assets, but as outlined periodical inspections are to be carried out by third parties.

The same applies to e.g. quality audits (e.g. ISO 9001). Internal (self-) audits can be carried out, but third party audits are mandatory as part of the certification and/ or approval process.

I.e. in-house inspections etc. are recommended but cannot and will not replace mandatory third party inspections etc.

The following federal code refers to the inspection activities that BOEM is responsible for, but this responsibility is now under the scope of BSEE.

30 CFR 585 – Renewable energy and alternate uses of existing facilities on the OCS

Subpart H – Environmental and Safety Management, Inspections, and Facility Assessments for Activities Conducted Under SAPs, COPs and GAPs

§ 585.824 How must I conduct self-inspections?

a) You must develop a comprehensive annual self-inspection plan covering all of your facilities. You must keep this plan wherever you keep your records and make it available to BOEM inspectors upon request. Your plan must specify:
    i. The type, extent, and frequency of in-place inspections that you will conduct for both the above-water and the below-water structures of all facilities and pertinent components of the mooring systems for any floating facilities; and
    ii. How you are monitoring the corrosion protection for both the above-water and below-water structures.
b) You must submit a report annually to us no later than November 1 that must include:
    i. A list of facilities inspected in the preceding 12 months;
    ii. The type of inspection employed (i.e., visual, magnetic particle, ultrasonic testing); and
    iii. A summary of the inspection indicating what repairs, if any, were needed and the overall structural condition of the facility.

2.14. Inspections, Audits and Evaluations by Third-Party Contractors

In this section we address to what degree regulators rely on inspections, audits, evaluations or certifications performed by independent third-party contractors.

As outlined in section 1.13 European regulators and governing bodies request to have third party inspection, audits, evaluation and certification to receive e.g. building and/ or operating permission.

Self-inspection etc. are accepted for e.g. maintenance/ service inspection of the assets, but as outlined periodical inspections are to be carried out by third parties.

The same applies to e.g. quality audits (e.g. ISO 9001). Internal (self-) audits can be carried out, but third party audits are mandatory as part of the certification and/ or approval process.

I.e. in-house inspections etc. are recommended but cannot and will not replace mandatory third party inspections etc.

The scope and frequency for third party inspection is laid down in the certification reports, building and/ or operating permissions and can vary from project to project.

2.15. Inspections, Audits and Evaluations by Regulators

In this section we address to what degree regulators conduct their own independent inspections, audits, evaluations or certifications.

In Europe regulators and governing bodies request to have third party inspection, audits, evaluation and certification to receive e.g. building and/ or operating permission.

As a rule, regulators (e.g. building authorities) appoint third parties to carry out inspections, audits etc. on their behalf. The scope and frequency is set by the regulators and it is laid down in the certification reports, building and/ or operating permissions and can vary from project to project.

In the case of specific events (e.g. damage investigation) regulators might attend e.g. inspections.

The following federal code refers to the inspection activities that BOEM is responsible for, but this responsibility is now under the scope of BSEE.

30 CFR 585 – Renewable energy and alternate uses of existing facilities on the OCS

Subpart H – Environmental and Safety Management, Inspections, and Facility Assessments for Activities Conducted Under SAPs, COPs and GAPs

§ 585.820 Will BOEM conduct inspections?

BOEM will inspect OCS facilities and any vessels engaged in activities authorized under this part. We conduct these inspections:

a) To verify you are conducting activities in compliance with subsection 8(p) of the OCS Lands Act; the regulations in this part; the terms, conditions, and stipulations of your lease or grant; approved plans; and other applicable laws and regulations.
b) To determine whether proper safety equipment has been installed and is operating properly according to your Safety Management System, as required in § 585.810.

2.16. Inspections, Audits and Evaluations of Electrical Metering Apparatuses

In this section we address whether regulators conduct inspections/audits/evaluations of electrical metering apparatuses.

Metering is typically managed by the grid operator. Even when equipment is installed within the wind farm facility, it is specified, maintained, and inspected by the grid operator. In the case of OWfs, metering equipment is placed on shore at the point of interconnection. In examination of practices at US onshore wind farms as well as German on- and off-shore wind farms, the authors have not found any cases where certification bodies and authorities having jurisdiction over the wind farm require or perform inspections or evaluations of the metering equipment.

2.17. Inspections of Components by Manufacturers

In this section we address whether wind farm component manufacturers perform safety testing, inspections, and certifications before or after installation in the field and to what degree regulators rely on this these tests, inspections, and certifications.

Wind turbines which will be installed on- or offshore, need to have a Type Certificate (see also section 1.19). Part of the TC is also that the involved manufactures have a certified quality management system (QMS) in place (e.g. as a minimum meet the requirements according to ISO 9001). Part of this QMS is also that the manufacturing process (including certification process and final testing, safety testing) for its product is monitored by adequate tools and this is the responsibility of the manufacturer of e.g. the wind turbine and/ or its components. For a prototype these measures, which are in place to secure the product quality, are checked randomly by the certification body.

This also applies to any final acceptance tests and/ or safety tests or load tests, where a representative of the certification body needs to be present (e.g. based on the applicable standards and regulations).

For a project certificate the whole process from design to manufacturing, transport and installation commissioning is part of the project certification scope that is carried out by the certification body.

As part of the project certification random inspections (e.g. manufacturing, transportation, installation, commissioning) are carried out by the involved certification body. These inspections are carried out in addition to the inspections and test of the component manufacturer.

In the O&M phase maintenance and service is necessary. This is done by e.g. the turbine manufacturer and the certification body carries out periodic inspection (e.g. every 4 years or a certain percentage of the entire wind farm annually). This is necessary to maintain the issued certificate for the wind turbine (type certificate) and/ or wind farm (project certificate).

This means that regulators rely on the competence of certification bodies and on a functioning QMS (of the component manufacturer and the certification body), i.e. component manufacturers carry out their own inspections and tests as part of their QMS and this process in monitored (e.g. by spot checks, random inspections) by the certification body.

Regulators rely on certificates issued by 3rd parties/ certification bodies, which are accepted by the regulators.

2.18. Capability Requirements for WTG Inspectors

This section is dedicated to training programs, qualifications, and/or expertise, which are required to carry out inspection works at onshore or offshore wind farms (including OSP and Met-Mast).

Besides having technical qualifications and technical safety trainings, such as working with electricity, equipment with stored energy etc. for a particular assignment an inspector must hold valid certificates for the following trainings and qualification in order to work on onshore or offshore wind turbines in Europe:

2.18.1. First Aid (on- and offshore)

In this section we address what training programs, qualifications, and/or expertise are required for onshore or offshore wind turbine inspectors.

a. Besides having technical qualifications and technical safety trainings, such as working with electricity, equipment with stored energy etc. for a particular assignment an inspector must hold valid certificates for the following trainings and qualification in order to work on onshore or offshore wind turbines in Europe:Understanding of the importance of carrying out First Aid in a safe and sound manner in accordance with the legislative requirements of their geographic location and according to ERC and AHA guidelines[65].
b. Able to identify and explain normal function, normal signs, functions and symptoms of serious and minor injuries and illness related to the human body.
c. Able to demonstrate understanding and correct order of management in an emergency situation in a WTG environment.
d. Able to demonstrate correct use of lifesaving first aid using the primary survey A-B-C.
e. Able to demonstrate correct use of an automatic external defibrillator (AED)
f. Able to demonstrate correct use of ordinary First Aid, the secondary survey
g. Able to demonstrate correct use of first aid equipment in a first aid scenario

Validity: The first aid certificate, as it is commonly known, is only valid for a limited time, and the inspector needs to renew it to continue working. The frequency for renewal is normally 2 years but it depends on the authority controlling the asset the inspector is visiting.

2.18.2. Fire Awareness (on- and offshore)

Typical fire awareness course content includes the following:

a. Able to demonstrate knowledge of the development and spread of fire
b. Able to demonstrate knowledge of the development and spread of fire
c. Able to identify any sign of a fire in a wind turbine environment
d. Able to demonstrate knowledge of the contingency plans in a wind turbine environment including smoke detection and emergency escape procedures.
e. Able to demonstrate correct actions on discovering a fire including correct operation and fire extinguishing by means of the firefighting equipment in a WTG.

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[65] American Heart Association Statements and Guidelines

http://my.americanheart.org/professional/StatementsGuidelines/Statements-Guidelines_UCM_316885_SubHomePage.jsp

Validity: The Fire awareness certificate, as it is commonly known, is only valid for a limited time, and the inspector needs to renew it to continue working. The frequency for renewal is normally 2 years but it depends on the authority controlling the asset the inspector is visiting.

2.18.3. Manual Handling (on- and offshore)

Typical manual handling training content includes the following:

a. Able to demonstrate understanding of the importance of carrying out work duties in a safe and sound manner in accordance with the legislative requirements of their geographic location.
b. Able to identify aspects of their job tasks that could increase a worker's risk of developing muscular / skeletal injuries
c. Able to demonstrate understanding of safe practices for manual handling including the correct handling of equipment
d. Able to identify signs and symptoms of injuries related to poor manual handling techniques and have knowledge of reporting methods
e. Able to demonstrate a problem solving approach to manual handling in a wind turbine environment
f. Able to demonstrate manual handling risk reduction techniques

Validity: The manual handling certificate, as it is commonly known, is only valid for a limited time, and the inspector needs to renew it to continue working. The frequency for renewal is normally 2 years but it depends on the authority controlling the asset the inspector is visiting.

2.18.4. Working at Heights (on- and offshore)

Typical working at heights training content includes the following:

a. Understand general health and safety duties of employers to provide training and ensure competence of employees;
b. Personal responsibilities of employees and the self-employed;
c. Overview of relevant legislation (HSW, WAH, MHSW, LOLER, PUWER, PPE 2002,PPEW 1992);
d. Outline of WAH and the principles of a hierarchical approach;
e. Basic reference and application of ACOPs, standards and guidelines (e.g. HSE,BS/EN);
f. Generic safe systems of work (e.g. permits & procedures);
g. Wind Turbine Safety Rules (scope & application);
h. Risk assessments and control measures for WAH;
i. Housekeeping risks relevant to/for WAH;
j. Planning of operations for WAH;
k. Different types of equipment use for WAH;
l. Equipment pre and post use checks, including certification of equipment;
m. Safe and correct use of equipment for WAH;
n. Equipment identification and selection for WAH;
o. Conflicting activities and tasks;
p. Environmental factors (e.g. weather);

q. Manual handling and ergonomics;
r. Appreciate relevance of different turbine designs (size/layout) to WAH & rescue situations;
s. Appreciate the relevance of different company/site specific H&S procedures and rules
t. Able to safely inspect (prior to use), correctly fit, and use PPE for WAH applications;
u. Able to work safely at height in a tower or simulated conditions;
v. Able to safely carry out a self-rescue in a tower or simulated conditions;
w. Able to safely carry out a rescue of a casualty in a tower or simulated conditions;
x. Able to safely carry out an assisted lower in a tower or simulated conditions;

Validity: The working at heights certificate, as it is commonly known, is only valid for a limited time, and the inspector needs to renew it to continue working. The frequency for renewal depends on the country (Germany every year, UK every 2 years) and authority controlling the asset the inspector is visiting.

2.18.5. Sea Survival or Basic Offshore Safety Induction and Emergency Response Training (BOSIET)

Typical sea survival or basic offshore safety induction and emergency response training content includes the following:

a. Principles for survival at sea.
b. Evacuation means.
c. International and national legislation.
d. Suits and life jackets used in the offshore industry.
e. Safe conduct in work situations, emergency situations and contingency plans.
f. Life boat, life raft, and life buoys.
g. Davit launchable life rafts and exercise with capsized raft.
h. Techniques to enhance survival at sea.
i. Treatment of coldness and hypothermia.
j. Use of pyrotechnical equipment.
k. Helicopter hoist.
l. Safely entering water from a height.
m. Right inverted life raft.
n. Offshore installation and vessels working in the offshore industry.
o. Swim and keep afloat while wearing a life jacket.
p. Operation with small boats including MOB (man over board) techniques.
q. Transfer of personnel and luggage between dock -boat and boat installation and between vessels making way.
r. Electronic distress signal devices such as EPIRB, SART and PLB.

Validity: The Sea Survival certificate, as it is commonly known, is only valid for a limited time, and the inspector needs to renew it to continue working offshore. The frequency for renewal is normally 4 years but it depends on the authority controlling the asset the inspector is visiting.

2.18.6. Helicopter Underwater Escape Training

This training requirement is optional for offshore transportation and it is only required when the transport to or from the offshore site is carried out via helicopter. Typical helicopter underwater escape training content includes the following:

a. Helicopter safety
b. Helicopter escape
c. The use of a helicopter transit suit and life jacket
d. Practice in using the Emergency Breathing System
e. Evacuation from a helicopter
f. Life raft procedures
g. Underwater escape exercises and BRACE position
h. Inflating life jackets in water
i. Boarding a life raft
j. Sea survival swim sessions

Validity: The Helicopter Underwater Escape Training certificate, as it is commonly known, is only valid for a limited time, and the inspector needs to renew it to continue working offshore. The frequency for renewal is normally 4 years but it depends on the authority controlling the asset the inspector is visiting.

2.18.7. Medical Checks

In addition to the trainings mentioned above all personnel have to fulfill statutory requirements with regards to medical checks, e.g. all personnel working on onshore and offshore wind turbines must be medically fit and capable of performing work under demanding situations. In Germany the inspectors need to fulfill for on- and offshore work the G41. The G41 is a medical examination in accordance with regulatory employers' insurance guidelines for all personnel working at heights. It includes performance and resilience of cardio-vascular levels, balance system, eyesight and hearing.

Every offshore inspector must undergo and pass an additional medical examination which classifies them as medically fit to work in the offshore environment.

Different offshore authorities have different requirements. For UK waters only physicians who are approved by the United Kingdom Offshore Operators Association (UKOOA) Health Advisory Committee should carry out the examination and issue certificates. For German waters the physicians carry out the examination according to the recommendation of the "Deutsche Gesellschaft für Maritime Medizin" (DGMM).

The offshore medical certificate, as it is commonly known, is only valid for a limited time, and the inspector needs to renew it to continue working offshore. The frequency for renewal depends on the authority controlling the asset the inspector is visiting and her or his age.

For UK waters, all assets are controlled by UKOOA and renewals are necessary for every 2 years irrespective of the age of the offshore inspector.

Individual Operators retain the right to request medical assessments more frequently.

Although UKOOA and DGMM set out the minimum to be included in the medical, contractors report that some doctors carry out a more in-depth examination than others. A typical examination will begin with you filling out an extensive form on your medical history, and lifestyle e.g. alcohol consumption, exercise etc. After this a physical examination will be carried out:

a. Urine check (for protein and sugar)
b. Height, weight and resultant Body Mass Index calculation
c. Blood pressure and pulse
d. Basic eye sight test including color vision
e. Lung capacity check
f. Hearing test
g. A physical examination by a doctor. Check stature, listen to your breathing, reflexes etc.
h. The doctor will also discuss the form you filled in, and carry out any additional checks they think necessary.

The Offshore Operators Association from three countries involved in the North Sea: the UK (UKOOA); Norway (OLF); and The Netherlands (NOGEPA) have signed a reciprocal agreement known as the Hardanger Agreement which states that a valid medical certificate in one country will be valid in the two other countries within the agreement.

2.18.8. Recommendations for Capability Requirements

There are no mandatory training schemes or standards that specifically apply. Each duty holder is responsible for identifying their own training requirements, and determining whether any particular training standards or schemes can fulfil these needs. However, standards and schemes that have been developed and supported through industry consensus are likely to be regarded as a benchmark of good practice. This is relevant in the event of enforcement or intervention action by regulators, as it may show evidence that recognized good practices have been adopted. It is recommended that where they are suitable for the risk profile and job role performed, preference should be given to the “standards” below in the following order of priority.

a. Benchmark standards: These standards have been developed by the industry to address significant risks that are specific or particular to the sector, and are supported by suitable third party accreditation systems. Relevant examples include:

i. Global Wind Organization – Basic Safety Training[66]: This Standard has been developed in response to the demand for recognizable Basic Safety Training (BST) in the industry. GWO is a

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[66] Global Wind Organization Standard – Basic Safety Training (BST) (Onshore/Offshore) , 2014

http://www.windpower.org/download/2277/GWO_BST_Standard_Version_6%2C_12_March%2C_2014.pdf non-profit organization of wind turbine owners and wind turbines manufacturers and was established between Vestas, REPower (now Senvion), Suzlon and Siemens Wind Power in November 2009. The aim of GWO is to strive for an injury free work environment in the wind turbine industry, through cooperation among the members, in setting common standards safety training and emergency procedures

ii. RenewableUK Training Standards[67]

b. External standards: These standards may address specific risk areas but either do not include adequate Offshore Renewable Energy Installation specific content and / or include elements that are unnecessary, or even potentially conflicting with Offshore Renewable Energy Installation specific approaches. There are numerous potential examples, with the most relevant likely to be those used in:

i. Oil and Gas, such as OPITO
ii. Marine contracting, such as IMCA; or 69
iii. Marine operations, such as Certificates of Competency under STCW.
iv. Internal standards

We **recommend** BSEE to demand on- and offshore wind farm owners to comply with the Global Wind Organization - Basic Safety Training – Standard.

2.19. Standards for OWF Installation and Operation Practices

In this section we address what standards exist that govern OWF installation or operation and what standards international wind energy regulations incorporate by reference (e.g., Norsk Sokkels Konkuranseposisjon [NORSOK]).

2.19.1. IEC Standards

Inspection of the installation of OWFs is addressed under the IEC 61400-22, which provides the criteria for project certification of OWFs, and more generally under 61400-3, which outlines the design requirements for OWFs. Under the IEC project certification scheme, inspection or surveillance is required of the activities in this section, to be carried out by the certification body.

2.19.1.1. Wind Turbine Transportation and Installation

The purpose of transportation and installation surveillance is to verify that the requirements stated of the design basis are adhered to, the loads on components do not exceed design envelopes during transport, and to detect any damage during transport and installation.

The certification body is required to ensure that components are inspected for damage that may have occurred in transport and installation handling, including (but not limited to) any damage to the corrosion protection system or actual corrosion of the structure. If a suitable quality management plan

[67] RenewableUK Training Standards, 2014

http://www.renewableuk.com/en/our-work/health-and-safety/training/

for transportation and installation exist, the certification body may elect to audit the transportation and installation records. Otherwise, inspection and witnessing of these activities is required. After the completion of installation activities, the certification body is obligated to make a visual inspection of all relevant components.

Per IEC 61400-22, surveillance of the following items shall be carried out and reported on by the certification body:

a. Monitoring of sea-transportation
b. Compliance with respect to acceptable weather conditions during transport and installation
c. Compliance with support structure and wind turbine installation procedures

The IEC 61400-3[68] design standard for offshore wind turbines requires inspection of the following to ensure proper connection and assembly during installation:

a. Guys
b. Cables
c. Turn buckles
d. Gin poles
e. Lifting devices
f. Other apparatus and devices

Per IEC 61400-3, items which should be inspected or maintained according to the facility operation and maintenance plan include:

a. Guy cables (tension)
b. Bolts (torque and tension loading)
c. Lubrication

2.19.1.2. Wind Turbine Commissioning

The term wind turbine commissioning generally refers to a series of standard operational tests that a fully erected turbine is put through to ensure that it was assembled and synchronized to the electrical grid properly. As the wind turbine manufacturer is most familiar with their turbines requirements and installation procedures, they are best suited to commission the wind turbines. The purpose of commissioning surveillance is to verify that the wind turbines installed at the site are commissioned in a manner conforming to relevant manuals and design documentation.

Per IEC 61400-22, the certification body is obligated to witness the commissioning of at least one turbine and at least one turbine for every 50 turbines in the project.

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[68] Section 13.11

2.19.1.3. Marine Growth

Per IEC 61400-3, a strategy for inspection and possible removal of marine growth should be planned as part of the support structure design.

2.19.1.4. Corrosion Protection System

Per IEC 61400-3, all coating systems used for corrosion protection should be subjected to an inspection and repair program to maintain their integrity.

2.19.1.5. Assembly of Wind Turbine

Per IEC 61400-3[69], inspection shall be carried out to confirm proper lubrication and pre-service conditioning of all components.

2.19.2. Germanischer Lloyd Guidelines

The guidelines for type certification of onshore and offshore wind turbines published by Germanischer Lloyd (GL) (now part of DNVGL) are some of the oldest and most widely applied wind energy standards. Other international bodies such as the IEC have modeled many of their wind energy standards and guidelines on GL publications.

While the GL guidelines primarily outline requirements for type certification, they also contain some guidance on installation and operation, including accompanying monitoring and inspections, as outlined in the following sections:

2.19.2.1. Installation

GL states that inspection of sea-fastening and marine operations should include:

(1) Condition inspection of vessels and equipment involved
(2) Load-out procedure including quay condition, mooring and retrieval system
(3) Transportation arrangements including sea-fastening, stability and towing
(4) Lifting/launching/upending procedure (rigging, mooring and clearances)
(5) Installation procedures including anchor handling, positioning, piling, grouting and mating

2.19.2.2. Commissioning

GL states that each wind turbine must undergo a commissioning procedure according to owner instructions written according to the guidelines. GL further states the commissioning procedure should be witnessed by the certification body at one of the first wind turbines of a new type, including visual inspection, safety function test, and witnessing of the condition monitoring system installation and commissioning. The experts witnessing the commissioning are recommended to include one electrical expert and one safety expert.

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[69] Section 13.9

2.19.2.3. Inspection of Electrical Installations

GL states the electrical installations including the lightning protection system must be inspected after installation and before operation.

1. Installation of the electrical cabinets (earthing, connection of the incoming cables, fill factor of cable channels, etc.)
2. Installation of generator, frequency converters and motors (earthing, check of rating plates, etc.)
3. Installation of the medium-voltage switchgear in accordance with the Internal Arc Classification (IAC)
4. Cable routing and installation (bending radius, distance between cables according to the specified installation method, installation of cable loop in the yaw section, installation and filling factor of cable trays and pipes, connection of shields, identification of cables in accordance with the wiring diagrams, etc.)
5. Installation of the lightning protection system (installation of down-conductor system, installation of brushes, spark gaps and surge arresters, measures taken for protection of wind measurement sensors, connection of the down-conductor system to the earth electrode, installation of bonding bars, achievement of shielding measures, etc.)
6. Inspection of protection settings and their permanent marking according to Section 8.7.3.3 para 2 and 8.7.3.1 para 2
7. Inspection of the parameter set for the electrical rotor-blade pitch converter (if applicable) to be compliant with the parameters assessed during A-Design Assessment
8. Inspection of the air flow concept inside the hub, nacelle and tower according to Section 7.11 and 8.1.7.1.b

2.19.2.4. Periodic monitoring

GL guidelines stipulate periodic monitoring by the certification body of offshore wind turbines throughout the life of the wind farm. The scope and frequency are to be determined during the certification process.

During Periodic Monitoring, the complete offshore wind turbine including the rotor blades shall be inspected thoroughly. A specific checklist for the inspection shall be prepared on the basis of the documentation. The checklist shall also contain the assessment criteria.

The objective is to ensure the safety function and structural integrity of the offshore wind turbines. The inspections would include, for example:

Documentation

1. Approval and/or certification reports, including all annexes and supplements
2. Building and operation permit
3. Operating manual
4. Filled-out commissioning records
5. Filled-out maintenance checklist (maintenance records) of at least the last maintenance

6. Reports of previous periodic monitoring or condition surveys (e.g., Condition-based monitoring measurements [if available])
7. Proof and result of the annual oil quality check (at least the two last ones) of gear and hydraulic components
8. Documentation of modifications/repairs to the turbine and necessary approvals, if relevant
9. Reports of inspection of scour protection or seabed level
10. Reports of inspection of the underwater structures and splash zone
11. Annual report (e.g., trend analysis) of the monitored (by a Condition Monitoring System [CMS]; see Chapter 13) wind turbine components (at least the two last reports)

On-site Inspection

1. Visual inspection of entire installation
2. Structural integrity of the offshore wind turbine, including machinery
3. Functioning of the safety and braking systems
4. Scour protection, seabed level
5. Underwater structure and splash zone with regard to corrosion, condition of welds, marine growth and damage (e.g., from collision)
6. Concrete surfaces for cracks, abrasion, spalling and any signs of corrosion of the steel reinforcement and embedment, particularly in the splash zone, in areas exposed to sea ice, and where repairs have been carried out previously
7. Type, location and extent of corrosion control (i.e., coatings, cathodic protection system, etc.)

A list of common inspection points is given in Table 12 below.

Assembly	Inspection for / Possible defects
Rotor blade	Surface damage, cracks, structural discontinuities (Inspection from a lifting or stepping device: visual and structural examination using suitable methods (e.g. tapping, ultrasonic testing) Pretensioning of bolts Damage to the lightning protection system
Drive train	Oil and / or grease leakages, unusual noises, condition of the corrosion protection, lubrication, pretensioning of bolts Condition of the gears and bearings (oil sample, if relevant) Damage to the lightning protection system
Nacelle and force- and moment-transmitting components	Corrosion, cracks, unusual noises, lubrication, pretensioning of bolts, lightning protection
Climate control, dehumidifiers and air filters	Function, contamination, dirt
Hydraulic system, pneumatic system	Damage, leakages, corrosion, function
Support structure (tower, sub-structure and foundation) Monopile and intersection pieces	Corrosion, corrosion protection (e.g. cathodic protection), damages and deformation, cracks, abrasion, spalling, pretensioning of bolts, marine growth, welds, scour Including grouted connections (visual inspection), airtight sections
Safety devices, outside lighting, sensors and braking systems	Functional checks, compliance with the limiting values, damage, wear
Control system and electrics including transformer station and switchgear, Condition Monitoring System	Terminals, fastenings, functional checks, corrosion, dirt
Heli-hoist, boat landing, fenders Crane and crane foundations	Fastenings, function, corrosion, cracks, dirt, damages and deformation
Emergency shelter, sea rescue equipment, backup power supply	Functional checks, compliance with the limiting values, damage, wear
Perusal of documentation	Completeness, observance of the conditions, construction according to certified documents, test documents, maintenance carried out at regular intervals If applicable: execution of modifications / repairs according to approval

Table 12 – List of Common Inspection Points

2.19.3. ABS Guides

The American Bureau of Shipping (ABS) has published several guides for OWFs in the past several years including:

a. Guideline for Certification of Offshore Wind Farms

b. Guide for Building and Classing Bottom-founded Offshore Wind Turbine Installations (BOWTI)

c. Guide for Building and Classing Floating Offshore Wind Turbine Installations (FOWTI)

d. Guide for Building and Classing Wind Farm Support Vessels

The Guideline for Certification of Offshore Wind Farms is consistent with and references IEC 61400-22 and is relevant for jurisdictions requiring project certification. The Guideline can also be used for projects where the project owner requests project certification or verification. An overview of the process of project certification according to the ABS Guideline is illustrated in Figure 3.

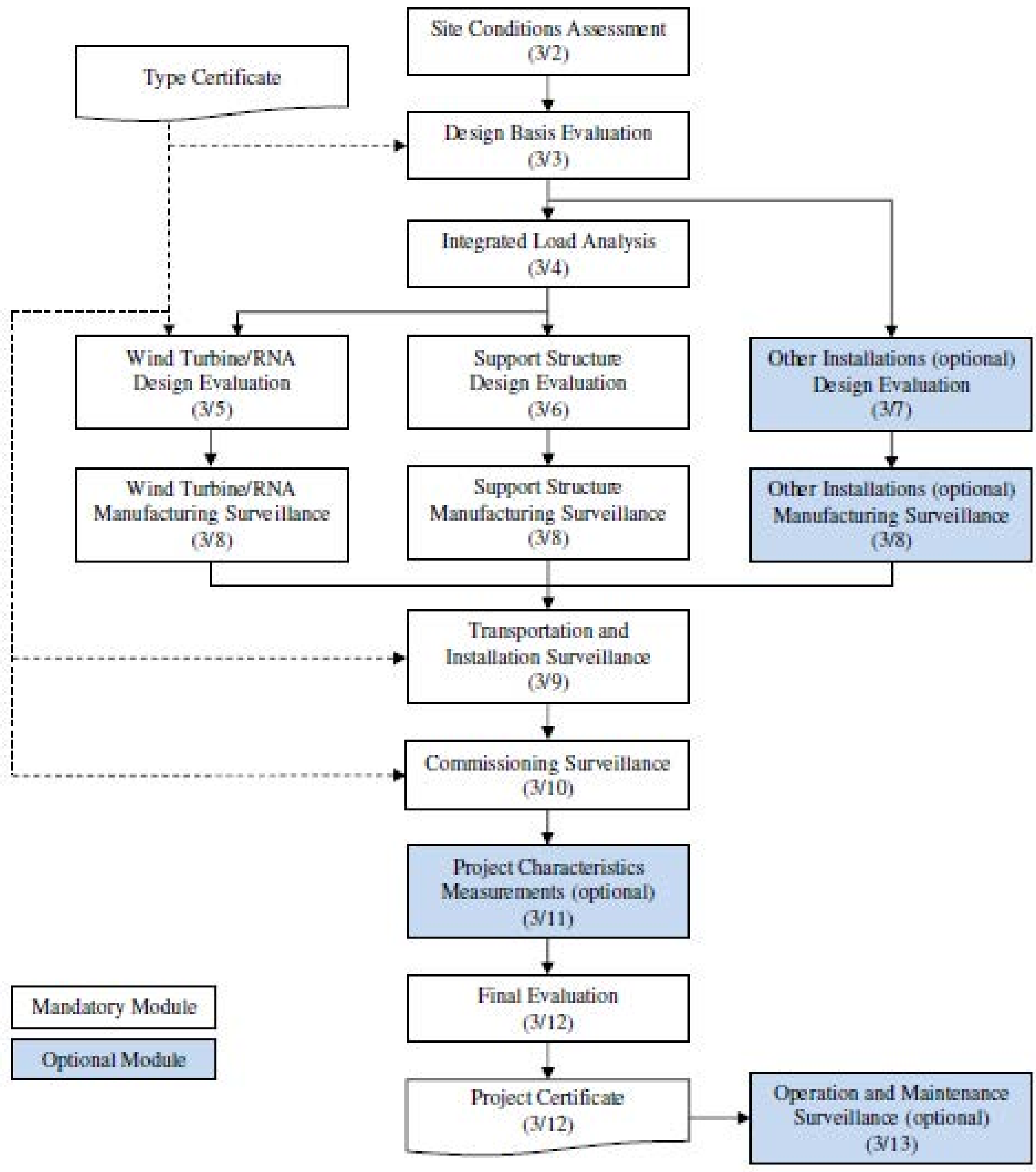

Figure 3 – Overview of Project Certification Process

The following sections are excerpted from the ABS Guideline for Certification of Offshore Wind Farms. Note that the numbering is from the ABS document and not this report.

2.19.3.1. Maintenance of the Project Certificate

The Project Certificate affirms that, at the date of issuance, an offshore wind farm, with or without the Optional Installations as recorded on the certificate, is in conformity with the stated requirements. The

Project Certificate may be renewed annually when a verification and periodic survey arrangement during the life cycle of the wind farm is established upon the agreement between ABSG and the Owner. Reference is made to 3/13 for the guidance on the survey during operation and maintenance.

8.2 Manufacturing Survey Requirements

Manufacturing surveys of the Rotor-Nacelle Assembly (RNA) should be based on relevant standards in conjunction with the approved RNA design documentation such as drawings and specifications, identified critical items and processes, test programs, etc. General guidance on the RNA manufacturing surveys is provided in IEC 61400-22, Section 9.8. In general, the RNA manufacturing surveys include:

a. Evaluation of manufacturer's quality management system
b. Periodic surveys of the manufacturing of main RNA components and systems in order to verify the compliance with the approved quality management system
c. Witnessing of relevant material, component and system tests
d. Documentation review for relevant certificates, specifications, procedures, test documentation, production worksheets, etc.

Additional manufacturing survey requirements for the offshore wind farms are provided in the ABS rules and guides as listed in Table 13. For those installations not covered by ABS rules or guides, recognized industry standards may be applied.

9 Installation Survey

9.1 General

ABSG will conduct installation surveys of offshore wind turbines and, optionally, the Other Installations during their load-out at the pier and offshore installation at the site, to:

a. Verify that the items covered by the Project Certification are installed in compliance with the requirements of the approved design documentation;
b. Witness relevant load-out and installation operations; and
c. Inspect for damages and overstresses that may have occurred during the installation.

Upon satisfactory completion of the certification module as required in this Subsection, a Statement of Compliance for installation surveys of offshore wind turbines and the specified Other Installations of the offshore wind farm may be issued.

9.2 Installation Survey Requirements

Prior to the first load-out and installation operations, load-out and installation procedures and checklists should be submitted for review and approval.

Refer to 1-2/3.21 or 1-2/5.15 of the ABS BOWTI Guide for the installation survey requirements relevant to the Bottom-founded Offshore Wind Turbines.

Refer to 11-1/5.1 of the ABS FOWTI Guide for the installation survey requirements relevant to the Floating Offshore Wind Turbines. Additional survey requirements for the inclining test or the equivalent weighing procedure are specified in 9-2/7 of the ABS FOWTI Guide.

The installation of the RNA and equipment and systems supporting operations of the RNA and hook-up of the electrical cables should be witnessed by the attending Surveyor.

Deviations from approved design documentation or any incidents such as damage or overstress to the RNA and the supporting structures during the installation may require re-submittal of additional documentation to provide an assessment of the significance of deviation and any necessary remedial actions to be taken.

As a minimum, installation surveys should be conducted for the load-out and installation of the first offshore wind turbine per each type in the offshore wind farm. Depending on the installation survey results as well as the number and type of offshore wind turbines in the farm, installations surveys may be extended to more offshore wind turbines to the satisfaction of the attending Surveyor.

Where the Other Installations of the offshore wind farm are included in the Project Certification, relevant installation survey requirements as specified in the ABS Offshore Installations Rules, Part 1 Section 2 or the ABS FPI Rules, Part 7 Chapter 1 should be satisfied. For those installations not covered by ABS rules or guides, recognized industry standards may be applied.

10 Commissioning Survey

10.1 General

ABSG will conduct commissioning surveys to verify that the installed offshore wind turbines and, optionally, the Other Installations are commissioned in accordance with the manufacturer’s requirements and instructions and in compliance with relevant design requirements of the approved designs.

Commissioning surveys involve documentation reviews and on-site surveys.

Upon satisfactory completion of the certification module as required in this Subsection, a Statement of Compliance for commissioning surveys of offshore wind turbines and the specified Other Installations may be issued.

10.2 Commissioning Survey Requirements

Prior to the commissioning of the first offshore wind turbine or the Other Installations covered by the Project Certification of the offshore wind farm, the commissioning procedures and checklists should be submitted for review and approval. The manufacturer's instructions should include all necessary procedures for testing the installed offshore wind turbine or the relevant Other Installations to confirm proper, safe and functional operation of equipment, systems and controls. The commissioning is to be carried out in accordance with the approved step-by-step commissioning procedures. The Surveyor is to be permitted sufficient access to verify that the procedures are satisfactorily accomplished.

Before the start of commissioning operations, the attending Surveyor will verify:

a. The safety of personnel by checking operational readiness of all lifesaving, fire detection and firefighting equipment, and unobstructed escape routes;
b. The establishment of communication procedures; and
c. The emergency procedures dealing with contingencies.

During commissioning surveys for offshore wind turbines, the attending Surveyor is to observe the offshore wind turbine operating under various capacities and conditions. As a minimum, the following procedures and tests should be witnessed by the attending Surveyor:

- Safe start-up
- Safe shutdown
- Safe emergency shutdown
- Safe shutdown from over speed (or representative simulations)
- Function test of protection systems
- Check of the control system settings
- Function test of automatic operations
- Function test of the yaw system, if applicable
- For the Floating Offshore Wind Turbines, additional commissioning surveys are required for the applicable marine systems and associated equipment and machinery, safety systems and associated equipment, and lifesaving appliances and machinery of the Floating Offshore Wind Turbines. Approved operations including emergency procedures should be verified to the extent deemed necessary by the attending Surveyor.

The overall performance of the RNA is to be verified for compliance with the design parameters of the approved designs. Records of all these verifications as well as the post-commissioning actions taken in accordance with the manufacturer's instructions should be included in the final commissioning reports and submitted to ABSG for review.

As a minimum, commissioning surveys should be conducted for one (1) offshore wind turbine per each type. Where there are more than fifty (50) offshore wind turbines of the same type, commissioning surveys should be conducted for at least one additional offshore wind turbine per every fifty (50) of the same type.

The selection of offshore wind turbines for commissioning surveys should reflect having surveys at the start and end of commissioning periods.

During commissioning surveys for the other Installations, the attending Surveyor is to observe the operations of main equipment, systems and controls under various capacities and conditions. As a minimum, the following procedures and tests should be witnessed by the attending Surveyor:

- Safe start-up
- Safe shutdown

- Function test of safety systems
- Check of the control system settings
- Function test of automatic operations

Records of the post-commissioning actions taken in accordance with the manufacturer's instructions should be included in the final commissioning reports and submitted to ABSG for review.

11 Project Characteristics Measurements

On request of the Owner, ABSG will verify that the optional measurements of performance-related characteristics of a specific wind turbine or an offshore wind farm at an offshore site are performed in accordance with approved standards and procedures.

Refer to IEC 61400-22, Section 9.11 for the certification requirements for project characteristics measurements for one or more of the following items:

i. Grid connection compatibility according to grid codes
ii. Verification of power performance
iii. Verification of acoustic noise emission

Measurement methodologies and procedures should be submitted for review and approval prior to performing the measurement. Witnessing of the measurements by the Surveyor may be required depending on the completeness of test laboratory's quality management system.

Upon satisfactory completion of the certification module as required in this Subsection, a Statement of Compliance for project characteristics measurements of specified items for the offshore wind turbine or the offshore wind farm may be issued.

13.2 Requirements for Surveys during Operation and Maintenance

The Operating and Maintenance Manuals and Procedures for the offshore wind farm should be submitted to ABSG for review. The requirements applicable to the scope and contents of the Operating and Maintenance Manuals and Procedures are described below:

i. For the Bottom-founded Offshore Wind Turbines, refer to IEC 61400-3, Section 14.4 and 14.5
ii. For the Floating Offshore Wind Turbines, refer to 1-1/11 of the ABS FOWTI Guide and the applicable part of IEC 61400-3, Section 14.4 and 14.5
iii. For the Other Installations, refer to applicable part of the ABS Offshore Installation Rules and the ABS FPI Rules, or other recognized industry standards

ABSG will verify that the Operating and Maintenance Manuals and Procedures are consistent with the relevant operation and maintenance requirements considered in the approved designs.

A Survey and Inspection Plan should be developed and submitted to ABSG for review and approval. The periodical surveys will be carried out by ABSG in accordance with the approved Survey and Inspection Plan to confirm that the items covered by the Project Certificate remain in compliance with the applicable certification requirements and other relevant standards. The Survey and Inspection Plan should cover all surveys relevant to the renewal of the Project Certificate for the design life of the offshore wind farm.

Prior to the surveys, the status of outstanding items (see 2/7), outstanding findings and recommendations from previous surveys, and all revisions made to the Operating and Maintenance Manuals and Procedures since the last survey should be submitted for review.

For the RNAs, the periodic surveys on the annual basis may be required for a selected number of the RNAs in the offshore wind farm. ABSG will review the operating and maintenance records to verify that:

i. Operations of the RNAs have been carried out in accordance with the approved Operating and Maintenance Manuals and Procedures
ii. Control settings of the RNAs have been regularly checked against the limiting values specified in the design documentation
iii. Maintenance of the RNAs has been carried out in accordance with the approved Operating and Maintenance Manuals and Procedures and by qualified personnel
iv. All repairs, modifications and replacements made to the RNAs are in compliance with the RNA type certificate and the Project Certificate requirements

For the RNAs, the surveys will also include inspections and, if applicable, witnessing of tests of the main components and systems such as:

a. Blades, hub, shaft and main nacelle structures
b. Mechanical systems
c. Electrical equipment and systems
d. Control systems
e. Protection systems
f. Personnel safety equipment, systems and installations
g. Corrosion protection systems

For other items and installations of the offshore wind farm covered by the Project Certificate, the recommended scope for surveys during operation and maintenance are listed in Table 13.

Installations and Systems	Relevant ABS Rules and Guides
Support Structures	*BOWTI Guide*, Section 1-2
Floating Support Structures	*FOWTI Guide*, Section 11-1
Stationkeeping Systems of the Floating Offshore Wind Turbines	*FOWTI Guide*, Section 11-1

Applicable marine systems and associated equipment and machinery, safety systems and associated equipment, and lifesaving appliances and machinery of the Floating Offshore Wind	*FOWTI Guide*, Section 11-1 *MODU Rules*, Part 7 Chapter 1, as applicable
Bottom-founded structures of the Other Installations	*Offshore Installations Rules*, Part 1 Section 2, as applicable
Floating structures and mooring systems of the Other Installations	*MODU Rules*, Part 7 Chapter 1 Section 2, as applicable *FPI Rules*, Part 6 Chapter 3
Electrical, mechanic and other systems and equipment on the Other Installations	*MODU Rules*, Part 7 Chapter 1, as applicable

Table 13 - References for Manufacturing Survey Requirements

13.3 Risk-based Surveys during Operation and Maintenance

A properly developed risk-based inspection plan or reliability centered maintenance plan may be credited as satisfying requirements of surveys during operation and maintenance for the offshore wind farm. The plan should be developed by the owner in accordance with the ABS Guide for Surveys Using Risk-Based Inspection for the Offshore Industry and the ABS Guide for Surveys Using Reliability-Centered Maintenance.

The application of the ABS guides referenced above does not cover any statutory survey requirements that may apply to the offshore wind farm. The owner should ensure that in developing the risk-based inspection plan, due consideration is given to all applicable requirements

2.19.4. DNV Offshore Standards

Offshore Standards published by DNV (now part of DNVGL) are widely used in Europe for site specific certification of OWFs. The DNV Offshore Standard DNV-OS-J101 is applicable to substructures designed for wind farms, but not to the wind turbines installed on the substructures. The following sections are excerpted from DNV-OS-J101:

2.19.4.1. Marine warranty surveys

101 A Marine Warranty Survey (MWS) may be required by the insurance company in order to effect an insurance for temporary phases such as sea transport and installation.

102 The purpose of an MWS is to ensure that the marine operations are performed within defined risk levels. These risk levels should be tolerable to marine insurance and also to the industry, as well as to the national and international Regulatory Bodies.

103 An MWS should be carried out in accordance with an internationally recognized standard. The DNV 'Rules for Planning and Execution of Marine Operations' represents a standard which is widely recognized by both insurance, finance and marine industries.

104 DNV 'Rules for Planning and Execution of Marine Operations', Part 1, Chapter 1, describes in detail the principles, the scope and the procedures for MWS. See also Subsection D.

105 Project Certification of wind farms does not include MWS. However, there are some synergy effects when DNV delivers both services. When DNV performs the MWS, the DNV surveyor for Project Certification will normally be present only during the first load-out and installation. The remaining surveys will be covered by the Marine Warranty surveyor.

2.19.4.2. Inspections during operation

Recommended for operator to develop a risk based inspection and maintenance plan according to local applicable regulations and standards.

2.19.4.3. Inspection results

401 The results of the periodical inspections shall be assessed and remedial actions taken, if necessary. Inspection results and possible remedial actions shall be documented.

2.19.4.4. Reporting

501 The inspection shall be reported. The inspection report shall give reference to the basis for the inspection such as national regulations, rules and inspection programs, instructions to surveyors and procedures. It shall be objective, have sufficient content to justify its conclusions and should include good quality sketches and/or photographs as considered appropriate.

2.19.5. UK OWF Installation and Operation Practices

In the UK, under The Crown Estate Act 1961[70], The Crown Estate is landowner of the UK seabed and areas of foreshore (www.thecrownestate.co.uk). The Crown Estate's permission, in the form of a site option Agreement and Lease is required for the placement of structures or cables on the seabed, this includes OWFs and their ancillary cables and other marine facilities. Potential OWF developers also require statutory consents from a number of UK Government departments before development can take place (e.g., a Food and Environment Protection Act 1 [FEPA1]) consent for the placement of structures in the sea or in the seabed; a Section 36 Consent 2[71] for the construction and operation of an offshore power station with a nominal capacity in excess of 1MW (within the territorial sea) or 50MW (beyond the territorial sea); a CPA3 consent for any works which are likely to obstruct or cause a danger to navigation, and which involve a construction or improvement of any works or the deposit of any

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[70] The Crown Estate Act 1961, http://www.thecrownestate.co.uk/media/5305/crown-estate-act-1961-text.pdf

[71] The UK the Marine Management Organization is responsible for considering and determining applications for consent under section 36 of the UK Electricity Act for offshore generating stations with a generating capacity of more than 1MW but less than or equal to 100MW, http://www.marinemanagement.org.uk/licensing/marine/activities/construction.htm

materials below the level of mean high water spring tide and in some cases planning permission for associated onshore works. A developer may also choose to apply for a section 36A declaration to extinguish the common law public right of navigation and fishing on the site of a renewable energy installation. In the UK, the key consents typically have strict monitoring requirements attached to them.[72]

2.20. Current Laws and Regulations for OWF, ONWF and WTGs

We addressed state laws or regulations that applicable to OWF, ONWFs and wind turbines in the sections from 1.1 to 6.1 above. We also provided detailed information about current laws and regulations in the appendices F, G, H and I. It is important to remember that except industry specific standards and guidelines, there are only a handful of regulations that are unique to OWF, ONWF or WTGs as most of the applicable regulations are long in force for other power generation assets.

While the existing laws and regulations have been applied to OWFs, ONWFs and WTGs in almost every single country, which is included in this study, we observed some changes and adaptation in some countries where either the application area of existing regulations are extended or references are made to international standards or guidelines to supplement the gaps in the regulations. For example, with the expansion of OWF projects in the UK, The Health & Safety Executive extended the coverage of Health and Safety at Work etc. Act 1974 to OWF development with the 2013 Order in order to make the regulations applicable for OWFs which are built within the UK territorial waters. Whereas Bulgaria, which went through major review and update of their legal system during the EU accession period, made reference to various IEC standards for WTG design in this process making the relevant standards applicable for ONWF and WTGs.

2.21. Wind Energy Trade Associations

In this section we address the major domestic and international wind energy trade organizations (e.g., American Wind Energy Association [AWEA]). The Contractor shall address how these organizations engage with industry, as well as how they develop standards or guidance relating to inspections, audits, certifications, or evaluations.

2.21.1. National Wind Energy Trade associations

2.21.1.1. AWEA

The AWEA is the largest U.S. trade association in the wind energy field. They are, along with the European Wind Energy Association (EWEA), the largest and most influential trade organizations globally. They host several wind-specific conferences, workshops and symposiums in the U.S. with the annual Windpower conference being their major annual event. The annual AWEA Offshore Windpower conference is their offshore specific event.

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[72] Appendix 5 – Regulatory Controls, Offshore Energy Strategic Environmental Assessment,

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/194352/OES_A5_Controls.pdf

While wind energy policy advocacy, education and conferences are a primary focus of theirs, they are also involved with publishing wind industry standards, such as AWEA Offshore Compliance Recommended Practices (2012), Health & Safety Best Practice Guidelines for Offshore, and AWEA Operation and Maintenance Recommended Practices.

2.21.1.2. EWEA

The European Wind Energy Association (EWEA) is the European counterpart to AWEA. They host several wind-specific conferences, workshops and symposiums in Europe with the annual EWEA conference being the largest. EWEA Offshore is their annual offshore specific conference.

They are involved with wind energy advocacy, education and the hosting of conferences and workshops. They also publish various reports, but do not publish any standards as such.

2.21.1.3. RenewableUK (formerly the British Wind Energy Association [BWEA])

RenewableUK is focused on wind energy policy advocacy, education and often hosting relevant conferences, symposia and workshops within Great Britain. Their main annual conference is called RenewableUK and the offshore specific conference is called Global Offshore Wind. They publish several wind energy reports and guides, many of which are specific to the offshore wind industry.

2.21.1.4. CanWEA

The Canadian Wind Energy Association (CanWEA) is focused on wind energy policy advocacy, education and often hosting relevant conferences, symposia and workshops within Canada. The only standard or recommended practice document they publish is the "Best Practices for Community Engagement and Public Consultation."

2.21.1.5. JWPA

The Japan Wind Power Association (JWPA) is basically a wind energy industry group working toward policy advocacy, industrial collaboration and education. They do not host any conference or publish any standards.

2.21.1.6. CWEA

The China Wind Energy Association (CWEA) is basically focused on wind energy policy advocacy, education and hosting relevant conferences within China. The annual China Wind Power conference is co-hosted by CWEA. They do publish several wind industry surveys, reports and a periodical titled Wind Energy which focuses on the interpretation of new policies and new laws, deliver the new technology and recent news in wind industry. They do not publish any standards.

2.21.1.7. BWE

The German Wind Energy Association (BWE) is basically focused on wind energy policy advocacy, education. They do not host any conferences or publish any standards. They do publish several wind industry surveys and reports.

While not associated with BWE, Husum Wind is a large biennial trade fair held in September in Husum, Germany. It is well attended and rivals the annual EWEA conference in size.

2.21.1.8. DWIA

The Danish Wind Industry Association (DWIA) is basically a wind energy industrial group which works to promote policy advocacy, wind energy education and collaboration within Denmark.

DWIA also hosts the Global Wind Organization. This is a non-profit industrial consortium of many of the large wind turbine manufactures. Their focus is in developing common worker safety training standards.

2.21.2. State Wind Energy Trade Associations

There are several U.S. state wind energy associations, such as the following:

- California Wind Energy Association (CalWEA)
- South Dakota Wind Energy Association (SDWEA)
- Iowa Wind Energy Association (IWEA)

These state agencies are primarily focused on promoting the use and development of wind energy in their state. They also are engaged in state policy promotion and education. They generally do not get involved in offshore matters, publishing standards or inspection related areas.

2.21.3. Industrial or Manufacturing Wind Energy Trade Associations

2.21.3.1. G9

The G9 Offshore Wind Health and Safety Association is a consortium of nine largest offshore wind developers. They are as follows: Centrica, DONG Energy, E.ON, RWE Innogy, Scottish Power Renewables, SSE, Statkraft, Statoil and Vattenfall. Their primary aim is to create and deliver world class health and safety performance in the offshore wind industry. They have published the following good practices guidelines:

- Working at height in the offshore wind industry
- The safe management of small service vessels used in the offshore wind industry

2.21.3.2. CREIA

The Chinese Renewable Energy Industry Association (CREIA) is an industrial group which acts as a liaison between academia, regulatory agencies and industry. They do not host any events. They publish several renewable energy reports and surveys, but not any standards.

2.21.4. International Wind Energy Trade Associations

2.21.4.1. GWEC

The Global Wind Energy Council (GWEC) is an international trade association for the wind power industry. Their focus is as a wind energy advocacy, policy and educational outreach. They publish several wind energy reports and surveys.

2.21.4.2. WWEA

The World Wind Energy Association (WWEA) is another international trade association for the wind power industry. Their focus is as a wind energy advocacy, policy and educational outreach. They publish several wind energy reports and surveys.

2.21.4.3. IEA Wind

The International Energy Agency (IEA) Wind agreement is a vehicle for member countries to exchange information on the planning and execution of national large-scale wind system projects and to undertake co-operative research and development (R&D) projects called Tasks or Annexes.

2.22. Accident Reporting

In this section we will address whether OWF and ONWF accidents/incidents (domestic or international) are currently reported and if so, how they are reported and to whom they are reported.

In this section we will address whether OWF and ONWF accidents/incidents (domestic or international) are currently reported and if so, how they are reported and to whom they are reported.

An accident is a sudden, unplanned, unforeseen event, which results in an unwanted outcome either in the form of personal injury or damage to plant/equipment or environment. An accident should be recognized as being distinct from any spontaneous manifestation of symptoms developed over a period of time due to an underlying medical condition. An accident can also be an act of non-consensual physical violence done to a person at work. We can group the accidents in four categorize:

a. Non-Lost Time Accident: This is an accident that although a person has received an injury it was not serious enough for that person to be absent from work.
b. Lost Time Non-Reportable Accident: This is an accident, which results in a person being injured to the extent that they are unable to attend work from the next working shift.
c. Lost Time Reportable Accident: This is a fatality or an accident that results in the injured person being absent from work due to the injury for a period of more than 3 days and requires to be reported to the appropriate enforcing authority.
d. Major Injuries: A list of the major injuries that is reportable[73].

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[73] Major Injuries:

a. Any fracture other than that to the fingers, thumbs or toes.
b. Any amputation.
c. Dislocation of the shoulder, hip, knee or spine.
d. Loss of sight.
e. A chemical or hot metal burn to the eye or any other penetrating injury to the eye.
f. Any injury resulting from an electric shock or electrical burn (including any electrical burn caused by arcing or arcing products) leading to unconsciousness or requiring resuscitation or admittance to hospital for more than 24 hours.

e. Dangerous Occurrences: A dangerous occurrence is normally an accident which does not result in an injury but which clearly had the potential to cause a major injury. A list of the types of dangerous occurrences can be found in Appendix J.
f. Reportable Diseases: There are a number of diseases that if diagnosed as a result of work are reportable to the health and safety authority. A comprehensive list is provided in Appendix K.
g. Environmental Accidents: Accident that harms the environment.

Certain accidents are reportable to either the local health and safety authority or the local environmental safety authority. However, in practicality a single contact number should be established within an incident contact centre (ICC) within an office or construction site to alleviate the difficulty in deciding which one to contact. When contacted, the ICC should be prepared to forward the accident report to the appropriate enforcing authority.

When an accident occurs, and investigation should be carried out in order to establish the facts, review the causes resulting in an accident, draw conclusions on the cause of the accident and formulate recommendations to prevent further recurrence.

All managers must ensure that their staff and contractors are aware of the open and honest culture about safety to encourage the reporting of accidents. It is fully recognized that accidents and dangerous occurrences can be a result of failings in management controls and are not necessarily the fault of individual employees.

In all countries employers have a legal duty to report and record accidents under certain regulations, for example employers are required to report accidents under Reporting of Injuries, Diseases and Dangerous Occurrences Regulations in the UK; although this regulation makes no explicit demand to investigate accidents another UK regulation, Management of Health and Safety at Work Regulations 1999 state that "*Every employer shall make and give effect to such arrangements as are appropriate, having regard to the nature of his activities and the size of his undertaking, for the effective planning,*

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g. Any other injury that
   i. Leads to hypothermia, heat-induced illness or to unconsciousness,
   ii. Requires resuscitation, or
   iii. Requires admittance to hospital for more than 24 hours.
h. Loss of consciousness caused by asphyxia or by exposure to a harmful substance or biological agent.
i. Either of the following conditions which result from the absorption of any substance by inhalation, ingestion or through the skin – Acute illness requiring medical treatment: or
j. Loss of consciousness
k. Acute illness which requires medical treatment where there is a reason to believe that this resulted from exposure to a biological agent or its toxins or infected material.

Organization , control, monitoring and review of preventative and protective measures". The approved code of practice that accompanies this regulation in the UK states that monitoring includes adequately investigating the immediate and underlying causes of accidents and incidents to ensure remedial action is taken.

On the occurrence of an accident or unsafe condition, all employees have a duty to:

a. Take such emergency action, as is appropriate, to correct the unsafe condition and minimize loss,
b. Report all accidents (including property/equipment damage and the discharge of substances) as soon as reasonably practicable but within the employees shift,
c. Co-operate fully with any accident investigation, in order to minimize loss and prevent recurrence.

2.22.1. Training Requirements

All staff conducting accident/incident investigations must be suitably trained to ensure that effective accident/incident investigation, notification and reporting requirements are carried out.

As a minimum the training must include:

a. Communicating legal requirements
b. Reporting and recording systems
c. Procedures for control of accident area
d. Investigation techniques
e. Accident causation investigation
f. Correct completion of all documentation for recording and reporting

Training should also be given to anyone that requires putting information into the company's electronic accident recording system, where applicable.

2.22.2. General Reporting Requirements

As we all know not all accidents result in significant injuries which may otherwise cause persons being absent from work. In such occasions the following reporting procedure for non-lost time accidents should be followed. However, where the injury sustained is significant and the injured staff member or contractor needs time-off from work for recovery, the accident causing the injury should be reported without delay to their supervisor during normal working hours or the appropriate management centre out of normal working hours.

2.22.3. Non-Lost Time Accidents

This is accident which does not result in lost time at work. An example for such accident is an incident such as staff or contractor ending up having a deep cut to hand while stripping cable. In this scenario, the injured gets to taken to a hospital just after lunchtime where he receives three stitches. After this treatment he injured goes home that afternoon and returns to normal duties on the following day.

2.22.3.1. Reporting

In the event of a non-lost time accident the injured or someone on his behalf should report it immediately to his supervisor during normal working hours. If the accident occurs after regular working hours, the accident it should be reported to the person in charge of operations at the time or to their supervisor as soon as is reasonably practical but no later than 12 hours after the accident. The accident register should be completed as soon as possible after the accident. Upon notification of the accident the supervisor must inform the local H&S officer and, where applicable, appropriate trade union safety representative within 24 hours. The initial accident information should be recorded on the accident reporting and investigation form of the company. Where appropriate, the health and safety officer should notify the company's health and safety manager by either email or by phone as soon, as is reasonably practicable.

2.22.3.2. Investigation

Depending upon the severity of the accident, a local investigation should be carried out by the team leader or supervisor. The team leader or supervisor should use the accident reporting and investigation form to initiate the investigation of the accident. After completion the accident investigation the team leader or the supervisor should make the recommendations in the accident form, which needs to be agreed with the health and safety manager, the department manager, injured person and trade union safety representative, where applicable. Time scales for implementation of the recommendations should be set and agreed by all parties and the accident form should be signed off by health and safety manager, department manager, the team leader or the supervisor and injured person. Completion of each recommendation should be monitored using the electronic accident recording system, where applicable.

2.22.3.3. Recording

The team leader or the supervisor should ensure that the details of the accident are entered into the accident log book. This is a legal requirement under the relevant regulations in countries such as the UK, Denmark and Germany. The original accident form should be forwarded to appropriate department nominated person for logging into the electronic accident recording system, where applicable, within four days from the date of the accident. Copies of the completed accident form should be forwarded to the local health and safety officer and the trade union appointed safety representative, where applicable.

2.22.4. Lost Time Non-Reportable Accident

When the injury sustained has prevented the injured person from returning to work for between one and three days (inclusive) following the day of the accident, the accident qualifies as a lost time non-reportable accident. These types of injuries are normally of a serious nature but not one of the major injuries. As an example for an accident of this kind let's consider the following scenario. A staff member or contractor trips while entering a wind turbine on Wednesday. He receives a severe gash to the leg after striking the metal handle of a hatch opening. Injured gets taken to a hospital where he receives stitches. Injured cannot go to work on Thursday and Friday and returns to work on Monday.

2.22.4.1. *Reporting*

In the event of a lost time non-reportable accident the injured or someone on his behalf, should immediately report the incident to his supervisor during normal working hours. Out with normal working hours the incident should be reported to the appropriate person in charge. The accident log book should be completed as soon as possible after the accident.

Upon notification of the accident the supervisor must inform the department manager, the local health and safety manager and the appropriate trade union safety representative, where applicable, as soon as practicably possible. The initial information about the accident should be recorded on the accident form without delay in order to ensure that all relevant information recorded. The local health and safety manager should inform all members of the company's health and safety team by either email or by phone as soon as practicably possible.

2.22.4.2. *Investigation*

It is at this point that the department manager in consultation with the health and safety manager need to make a judgment call on whether or not the severity or potential severity requires a panel of inquiry to be initiated. If the decision is such that a higher level of investigation is required then the following process should be activated.

The key to a good accident investigation is that it is prompt, thorough, impartial and objective. It is imperative that as much evidence is collected as quickly as possible after the event. There are four simple ingredients that cover a good investigation and these are;

- Collection of Evidence
- Assemble and Consider the Evidence
- Compare the Evidence against Standards, Technical Specs and Procedures etc.
- Implement Findings and Track their Progress

a. Collection of Evidence: The evidence should be collected using the following methods:

i. Observations: This process includes observation of the physical surroundings, access, egress, plant and substances in use, location of physical parts, post-event checks, tests and most importantly photographs of the incident area.

ii. Interviews: This process involves interviewing those people who were either directly involved in accident or witnessed the accident such as co-workers, supervisor, maintenance and/or inspection staff.

iii. Documentation: This process involves examination of documentation such as written work instructions, risk assessment method statements, authorizations, training records, drawings, test records, surveys and previous incident records.

b. Assessment of Evidence: Information collected in the process above should be gathered and cross-examined for accuracy and reliability. The amount of evidence should be proportionate to the complexity and technical aspect of the incident, as should the numbers of people cross-examining the evidence. It is important to ensure that the evidence is assessed at in a systematic approach by verifying the statements.

c. Comparison: It is equally important to compare the evidence that has been collated against legal requirements, approved codes of practice, company's own safety procedures, risk assessment method statements, technical standards and national standards and industry standards.
d. Implementation: Once the process outlined above is complete, investigation process should be concluded, and based on the conclusions a set of recommendations should be made for implementation. The recommendations should be recorded either as part of a formal report for a panel of inquiry or in the appropriate section of the accident form for a local investigation. Time scales for implementation of the recommendations should be set and agreed by all parties and the accident form should be signed off by department manager, supervisor, injured person and safety representative. Completion of each recommendation should be monitored using an appropriate progress tracking system such as the electronic accident recording system.

2.22.4.3. Recording

The supervisor should ensure that details of the accident are entered into the accident book. This is normally a legal requirement under the applicable regulations of countries where wind farms are developed. If a panel of inquiry was established then the recording process of the panel of inquiry reporting procedure should be followed. The original accident form should be forwarded with the panel of inquiry number to appropriate department's nominated person for logging into the electronic accident recording system, where possible, within four days from the date of the accident. Copies of the completed accident form should be forwarded to the local health and safety manager and the safety representative of trade union, where applicable, a copy should also be retained with the full report if a panel of inquiry was established.

2.22.5. Lost Time Reportable Accident

A lost time reportable accident is where the injury sustained has prevented the injured person from returning to work for more than three days following the day of the accident. This type of injury is normally of a serious nature. As an example for an accident of this kind let's consider the following scenario. Staff or contractor slips while entering dry deck in the wind turbine foundation and tares ligaments in ankle. He is unable to return to work for four days after the day of the accident.

2.22.5.1. Reporting

Where a staff or contractor receives an injury that is severe enough which results in injured not being able to return to work for more than three days, it needs to be reported to the health and safety authority of the country as soon as possible and the injured must be hospitalized, but only if it is possible to ensure the accident area has been made safe and it is safe to move the injured person.

Arrangements must be made by those on the wind farm site for the team leader to be notified without delay in case such incidents. Once the injured person is attended by medics and the injury is reported, the accident book should be completed as soon as possible after the accident. The initial information should be recorded on the accident form at this point.

2.22.5.2. Investigation

It is at this point the department manager, in consultation with the health and safety manager should make a judgment call on whether or not the severity or potential severity requires a panel of inquiry to be initiated. If the decision is that a higher level of investigation is required then the process explained above should followed.

If the accident severity or potential severity does not require the initiation of a panel of inquiry, then a local investigation following the procedure for a non-lost time accident should be implemented. Depending on the severity or potential severity, the investigation may be carried out by the supervisor in conjunction with a member of staff from the health and safety department.

Having carried out a panel of inquiry or a local investigation, the responsible person should set out the recommendations. The recommendations should be recorded either as part of a formal report, for a panel of inquiry, or in the appropriate section of the accident register form for a local investigation.

Time scales for implementation of the recommendations will be set and agreed by all parties and the accident form signed off by department manager, team leader or supervisor, injured person and safety representative. Completion of each recommendation should be monitored using an appropriate monitoring system such as electronic accident recording system.

2.22.5.3. Recording

The supervisor should ensure that details of the accident are entered into the accident book. This is a legal requirement in almost all countries where wind farm are developed, presently.

If a panel of inquiry was established then the recording process of the panel of inquiry reporting procedure should be followed. The original accident register form should be forwarded to appropriate department's nominated person for logging into the electronic accident recording system within four days from the date of the accident, where applicable. Copies of the completed accident forms should be forwarded to the local health and safety manager and the trade union appointed safety representative, where applicable, a copy should also be retained with the full report if a panel of inquiry was established.

2.22.6. Fatalities to Staff or Contractors

2.22.6.1. 10.5.1 Reporting

In the event of a fatality to a staff member or one of the contractors, it should immediately be notified to the emergency services. The site of the accident should be left as it is unless it poses a further danger to staff, contractors or third parties. Having informed the emergency services, the staff on site should notify immediately their team leader during normal working hours and the relevant supervisor out with normal working hours. The accident book should be completed as soon as possible after the accident and initial details should be recorded using the accident register form.

2.22.6.2. Investigation

Any fatality should initiate a company board of inquiry. The techniques for investigating the accident are same as explained above. If the supervisor is the first person to attend site then he should use the accident reporting and investigation form to capture potentially vital information to aid the inquiry members, as the panel members may not be appointed immediately.

Having carried out the investigations above, the responsible person for the investigation should set out the recommendations. The recommendations should be recorded as part of a formal report; they should be agreed with the relevant parties on a timely basis. Time scales for implementation of the recommendations should be set and agreed by all parties. The inquiry chairperson should track each recommendation for completion and each one of them should be signed off as and when completed. Where possible, completion of each recommendation should be monitored using an electronic accident recording system.

2.22.6.3. Recording

The initial details of the incident should be recorded, if possible within the electronic accident recording system, within four days of the incident. All further information should be recorded under company specific procedures and applicable regulations. A copy of the accident form should be passed to the responsible person for completion, if possible on the electronic accident recording system; the accident must be recorded in the accident book where there is no such system. All documentation and reports should be recorded and maintained by the health and safety department.

2.22.7. Dangerous Occurrences

There are a number of different types of dangerous occurrences that are required to be notified to the relevant enforcing authority under relevant regulation of a country such as Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 in the UK. It is important to note that these occurrences can be electrical and non-electrical and may or may not involve injuries. An example of a dangerous occurrence can be given as an incident whereby a mini-digger overturns during an excavation operation when it topples over the edge of a kerb on Monday; there are no injuries sustained. As there is no injury or the injury is not notifiable to the enforcing authority then the near-miss must be notified to them. A list detailing the most common types of relevant dangerous occurrences can be found in Appendix J.

2.22.7.1. Reporting

Arrangements must be made by those on site for the supervisor to be notified without delay. Any dangerous occurrence, as listed in Appendix J, must be notified by the quickest possible means in order to enable the person in charge to notify the relevant enforcing authority without delay. Out of Hours reporting should be the responsibility of supervisor in charge, normal hours the SHE manager should perform this duty. Upon receipt of the notification the supervisor should promptly notify the department manager and the local SHE manager. Initial details of the dangerous occurrence should be recorded on the incident register form. The incident book should be completed as soon as possible after the incident.

2.22.7.2. *Investigation*

It is at this point that the department manager, in consultation with the SHE manager is required to make a judgment call on whether or not the potential severity of the incident requires a panel of inquiry to be initiated. If the decision is that a higher level of investigation is required then the above procedure should be followed.

The technique for investigating the dangerous occurrences is same as that of accident investigation. The supervisor should use the incident reporting and investigation form to capture potentially vital information about the dangerous occurrence to aid the panel of inquiry members, as the panel members may not be appointed immediately.

If the dangerous occurrence potential severity does not require the initiation of a panel of inquiry, then a local investigation following the procedure for a non-lost time accident should be implemented. Depending on the potential severity, the investigation may be carried out by the supervisor in conjunction with a member of staff from the SHE department.

Having carried out a panel of inquiry or a local investigation, the responsible person should set out the recommendations. The recommendations should be recorded either as part of a formal report, for a panel of inquiry, or in the appropriate section of the accident form for a local investigation.

Time scales for implementation of the recommendations should be set and agreed by all parties and the incident form should be signed off by department manager, supervisor, person who was subject to near-miss and safety representative. Either the panel of inquiry chairperson or the investigating supervisor should track each recommendation for completion. Completion of each recommendation should be monitored using the electronic accident recording system, where possible.

2.22.7.3. *Recording*

If a panel of inquiry was established then the recording process of the panel of inquiry reporting procedure should be followed. The original incident form should be forwarded to appropriate department's nominated person for logging into the electronic accident recording system within four days from the date of the accident, where possible.

Copies of the completed incident form should be forwarded to the local SHE manager and the trade union appointed safety representative, where applicable, a copy should also be retained with the full report if a panel of inquiry was established.

2.22.8. Reportable Diseases

In most of countries where wind farms are developed, companies are required to report certain diseases that persons at work suffer from as a result of working at OWF, ONWF, OSP, Met-Mast. A sample list of the types of diseases reportable to the enforcing authorities is listed in Appendix K. An example of a reportable disease can be given as an incident whereby a company receives confirmation from the doctor of an employee or contractor that he has been diagnosed with occupational dermatitis and that further medical examinations are carried out to establish the potential cause of this disease.

2.22.8.1. Reporting

It is the duty of any member staff or contractor to report to his supervisor immediately that his doctor has diagnosed him with a disease that may have resulted from work related activities. In this case, a written confirmation of the diagnoses should be sent to the appropriate HR department. In return the HR manager should inform the relevant department manager and the SHE manager upon written confirmation from a doctor that a member of staff or contractor is suffering from a work related disease. If it is established through the company's health surveillance program that a member of staff or contractor is suffering from one of the occupational diseases as defined in a relevant legislation, the SHE department should promptly notify the senior SHE manager and HR manager. The SHE department should complete the accident book and report confirmed cases of a work related disease as soon as possible.

2.22.8.2. Investigation

SHE manager should conduct any investigation into a confirmed or potential case of a reportable disease. The technique for investigating the reportable disease does not change from that of investigating an accident. Having carried out the investigations above, the responsible person for the investigation should set out the recommendations. Time scales for implementation of the recommendations should be set and agreed by all parties. The recommendations should be recorded as part of a formal report. The responsible person for the investigation should track each recommendation for completion. Completion of each recommendation should be monitored using the electronic recording system, where possible.

2.22.8.3. Recording

The supervisor should ensure that the details of the disease are entered into the accident book. This is a typically a legal requirement under applicable regulation of each country. The original disease form should be retained by SHE department for logging into the electronic recording system, where implemented. The records should be completed within four days from the date of the confirmation of the reportable disease.

2.22.9. Environmental Accident Reporting

It is an established practice to report environmental accidents to local authorities in most countries where wind farms are developed. An example of an environmental accident can be given as an incident whereby there is an oil leak into soil in an ONWF or major fuel discharge from a transportation vessel, which is used for transporting OWF maintenance and inspection crew.

2.22.9.1. Reporting

It is the duty of any member staff or contractor to report any environmental incident to SHE manager via his supervisor immediately. SHE manager is responsible to report the accident to the local environmental protection agency by following their incident reporting procedure. The initial information about the accident should be recorded on the accident form without delay in order to ensure that all relevant information recorded. The local SHE manager should inform all members of the company's health and safety team by either email or by phone as soon as practicably possible.

2.22.9.2. Investigation

It is at this point that the SHE manager, in consultation with the company director should make a judgment call on whether or not the potential severity of the incident requires a panel of inquiry to be initiated. If the decision is that a higher level of investigation is required then the investigation procedure explained above should be followed.

The technique for investigating the dangerous occurrences is same as that of accident investigation. The supervisor should use the incident reporting and investigation form to capture potentially vital information about the dangerous occurrence to aid the panel of inquiry members, as the panel members may not be appointed immediately.

If the dangerous occurrence potential severity does not require the initiation of a panel of inquiry, then a local investigation following the procedure for a non-lost time accident should be implemented. Depending on the potential severity, the investigation may be carried out by the supervisor in conjunction with a member of staff from the SHE department and the local environmental protection agency.

Having carried out a panel of inquiry or a local investigation, the responsible person should set out the corrective actions and recommendations, which should be recorded either as part of a formal report, for a panel of inquiry, or in the appropriate section of the accident form for a local investigation.

Time scales for implementation of the corrective actions and recommendations should be set and agreed by all parties including the local environmental protection agency and the accident form should be signed off by department manager, supervisor and SHE manager. Either the panel of inquiry chairperson or the investigating supervisor should track each corrective action and recommendation for completion. Completion of each corrective action and recommendation should be monitored using the electronic accident recording system, where possible.

2.22.9.3. Recording

If a panel of inquiry was established then the recording process of the panel of inquiry reporting procedure should be followed. The original accident form should be forwarded to appropriate department’s nominated person for logging into the electronic accident recording system within four days from the date of the accident, where possible. All accident related communications with the local environmental protection agency should also be documented and recorded.

Copies of the completed incident form should be forwarded to the local SHE manager and the environmental protection agency, as appropriate, a copy should also be retained with the full report if a panel of inquiry was established.

US regulatory code

The section of the US code which covers environmental accident reporting is 30 CFR 585.815 -833 which is repeated in the following:

30 CFR 585 – Renewable energy and alternate uses of existing facilities on the OCS

Subpart H – Environmental and Safety Management, Inspections, and Facility Assessments for Activities Conducted Under SAPs, COPs and GAPs

§ 585.815 What must I do if I have facility damage or an equipment failure?

a) If you have facility damage or the failure of a pipeline, cable, or other equipment necessary for you to implement your approved plan, you must make repairs as soon as practicable. If you have a major repair, you must submit a report of the repairs to BOEM, as required in § 585.711.
b) If you are required to report any facility damage or failure under § 585.831, BOEM may require you to revise your SAP, COP, or GAP to describe how you will address the facility damage or failure as required by § 585.634 (COP), § 585.617 (SAP), § 585.655 (GAP). You must submit a report of the repairs to BOEM, as required in § 585.703.
c) BOEM may require that you analyze cable, pipeline, or facility damage or failure to determine the cause. If requested by BOEM, you must submit a comprehensive written report of the failure or damage to BOEM as soon as available.

§ 585.816 What must I do if environmental or other conditions adversely affect a cable, pipeline, or facility?

If environmental or other conditions adversely affect a cable, pipeline, or facility so as to endanger the safety or the environment, you must:

a) Submit a plan of corrective action to BOEM within 30 days of the discovery of the adverse effect.
b) Take remedial action as described in your corrective action plan.
c) Submit to the BOEM a report of the remedial action taken within 30 days after completion.

585.830 What are my incident reporting requirements?

a) You must report all incidents listed in § 585.831 to BOEM, according to the reporting requirements for these incidents in §§ 585.832 and 585.833.
b) These reporting requirements apply to incidents that occur on the area covered by your lease or grant under this part and that are related to activities resulting from the exercise of your rights under your lease or grant under this part.
c) Nothing in this subpart relieves you from providing notices and reports of incidents that may be required by other regulatory agencies.
d) You must report all spills of oil or other liquid pollutants in accordance with 30 CFR 254.46.

§ 585.831 What incidents must I report, and when must I report them?

a) You must report the following incidents to us immediately via oral communication, and provide a written follow-up report (paper copy or electronically transmitted) within 15 business days after the incident:
   i. Fatalities;
   ii. Incidents that require the evacuation of person(s) from the facility to shore or to another offshore facility;
   iii. Fires and explosions;
   iv. Collisions that result in property or equipment damage greater than $25,000 (Collision means the act of a moving vessel (including an aircraft) striking another vessel, or striking a stationary vessel or object. Property or equipment damage means the cost of labor and material to restore all affected items to their condition before the damage, including, but not limited to, the OCS facility, a vessel, a helicopter, or the equipment. It does not include the cost of salvage, cleaning, dry docking, or demurrage);
   v. Incidents involving structural damage to an OCS facility that is severe enough so that activities on the facility cannot continue until repairs are made;
   vi. Incidents involving crane or personnel/material handling activities, if they result in a fatality, injury, structural damage, or significant environmental damage;
   vii. Incidents that damage or disable safety systems or equipment (including firefighting systems);
   viii. Other incidents resulting in property or equipment damage greater than $25,000; and
   ix. Any other incidents involving significant environmental damage, or harm.
b) You must provide a written report of the following incidents to us within 15 days after the incident:
   i. Any injuries that result in the injured person not being able to return to work or to all of their normal duties the day after the injury occurred; and
   ii. All incidents that require personnel on the facility to muster for evacuation for reasons not related to weather or drills.

§ 585.832 How do I report incidents requiring immediate notification?

For an incident requiring immediate notification under § 585.831(a), you must notify BOEM verbally after aiding the injured and stabilizing the situation. Your verbal communication must provide the following information:

a) Date and time of occurrence;
b) Identification and contact information for the lessee, grant holder, or operator;
c) Contractor, and contractor representative's name and telephone number (if a contractor is involved in the incident or injury/fatality);
d) Lease number, OCS area, and block;
e) Platform/facility name and number, or cable or pipeline segment number;
f) Type of incident or injury/fatality;
g) Activity at time of incident; and
h) Description of the incident, damage, or injury/fatality.

§ 585.833 What are the reporting requirements for incidents requiring written notification?

a) For any incident covered under § 585.831, you must submit a written report within 15 days after the incident to BOEM. The report must contain the following information:
    i. Date and time of occurrence;
    ii. Identification and contact information for each lessee, grant holder, or operator;
    iii. Name and telephone number of the contractor and the contractor's representative, if a contractor is involved in the incident or injury;
    iv. Lease number, OCS area, and block;
    v. Platform/facility name and number, or cable or pipeline segment number;
    vi. Type of incident or injury;
    vii. Activity at time of incident;
    viii. Description of incident, damage, or injury (including days away from work, restricted work, or job transfer), and any corrective action taken; and
    ix. Property or equipment damage estimate (in U.S. dollars).
b) You may submit a report or form prepared for another agency in lieu of the written report required by paragraph (a) of this section if the report or form contains all required information.
c) BOEM may require you to submit additional information about an incident on a case-by-case basis.

2.23. Type of Reported Accidents

In this section we address what types of accidents are generally reported in the wind energy sector.

According to European Agency for Safety and Health at Work over the past few years there has been an upwards trend in the number of accidents occurring in the wind energy sector. This is linked to the increased number of wind turbines, as more WTGs were installed, more accidents occurred. The Caithness Wind Farm Information Forum (CWIF), which gathers worldwide information on wind turbine related accidents through press reports or official information releases, provides statistics about accidents reported in the wind energy sector. These reports used for the research provide a crosssectional assessment of the types of accidents that occur and their consequences. Since 1970, the total number of accidents has exceeded 1,400, but most of these occurred over the last five years. According to statistics available on average, there were 141 accidents per year from 2008 to 2012, and, in 2013, by 30th September, 112 accidents had occurred. Since 1970, 104 fatal accidents have occurred causing 144 fatalities, and, of these, 87 deaths were among support workers within construction, maintenance and engineering or among small turbine owners and operators. The remaining 57 fatalities involved members of the public or individuals in some way not directly linked to wind energy production, including, for example, transport workers. A total of 99 accidents have caused human injury to wind industry or construction and maintenance workers, while 23 further accidents have caused injuries to members of the public or workers not directly involved in wind energy production, such as fire fighters and transport workers. Since 2012, CWIF has also included human health incidents in its statistics. These incidents include, for example, turbine noise and shadow flicker. There were six incidents impacting on human health in 2012 and 24 up to 30th in 2013. Such incidents are predicted to increase significantly as more turbines are built. CWIF believes that its compendium of accident information is the most comprehensive available, but stresses that it may represent only 9 % of actual accidents. Accident data in the wind energy sector are hard to find and usually the information available is not very comprehensive. Some national wind energy associations do publish accident statistics, and these data confirm that there are more accidents within the wind energy sector.[74]

According to CWIF, the accident data compiled and shown in the tables below is comprehensive as CWIF believes that it may not cover all accidents in terms of numbers of accidents and their frequency. CWIF stated that according to the Daily Telegraph report on 11th December 2011 RenewableUK confirmed that there had been 1,500 wind turbine accidents and incidents in the UK alone in the previous 5 years. However in CWIF data covers only 142 UK based accidents from 2006 to 2010 and therefore CWIF figures may only represent 9% of actual accidents by their own admission. But nevertheless, CWIF believes that this compendium of accident information may be the most comprehensive available anywhere ever collected in the wind energy field. CWIF confirms that the detailed Figure 4 – WTG Accident Trend Worldwide includes all documented cases of WTG related accidents and incidents which they could find and confirm through press reports or official information releases up to 31 December 2014. In the following section we share the accident information assembled and reported by CWIF within their recently published report "Summary of Wind Turbine Accident Data to 31 December 2014"[75].

CWIF reports that the accident trend has been as expected; as more WTGs were built, more accidents occurred. CWIF states that the numbers of recorded accidents reflect this trend, with an average of 16

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[74] Occupational Safety and Health in the Wind Energy Sector, European Risk Observatory Report, page 14, European Agency for Safety and Health at Work, 2013 https://osha.europa.eu/en/publications/reports/occupational-safety-and-health-in-the-wind-energy-sector

[75] Summary of Wind Turbine Accident Data to 30 September 2013, Caithness Windfarm Information Forum, Dec 2014, http://www.caithnesswindfarms.co.uk/accidents.pdf

accidents per year from 1995-1999 inclusive; 48 accidents per year from 2000-2004 inclusive; 108 accidents per year from 2005-2009 inclusive, and 155 accidents per year from 2010-2014 inclusive.

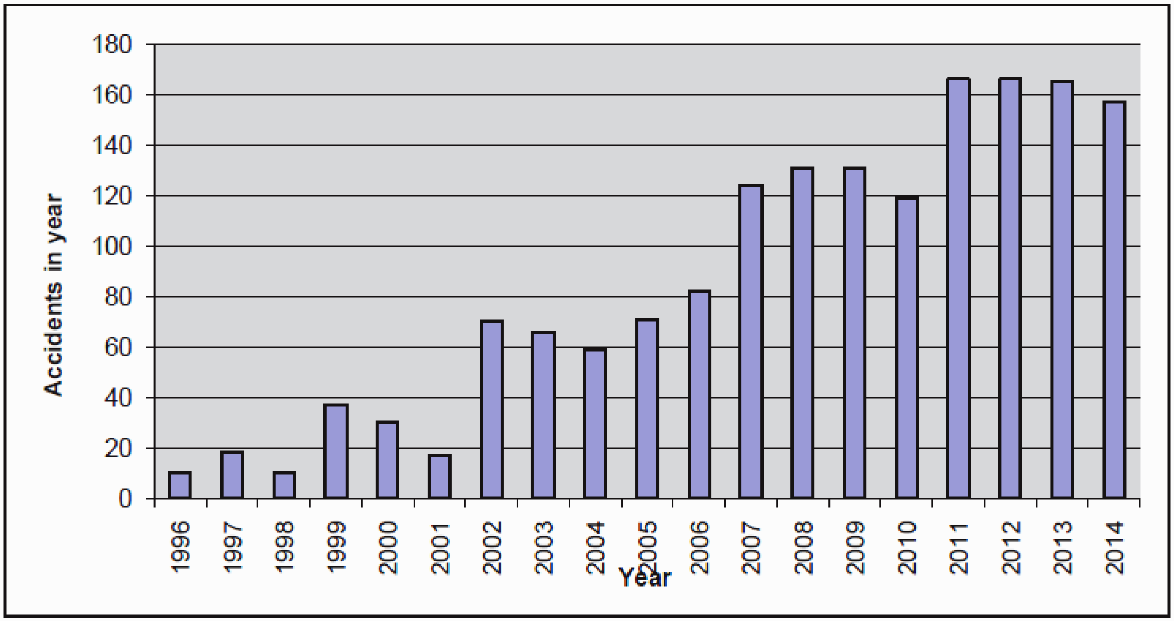

Figure 4 – WTG Accident Trend Worldwide

This general trend upward in accident numbers is predicted to continue to escalate unless health and safety authorities of countries where WTGs are installed make some significant changes in particular to protection of the public by declaring a minimum safe distance between new turbine developments and occupied housing and buildings. For example, in the UK, the Health and Safety Executive does not currently have a database of WTG failures on which they can base judgments on the reliability and risk assessments for wind turbines. Although the Health and Safety Executive commissioned "Study and Development of a Methodology for the Estimation of the Risk and Harm to Persons from Wind Turbines - R968 Report[76]" it still does not have the full data on WTG related accidents.

The health and safety authorities of some countries have started to assess the safety impact of WTGs, for example the Scottish government has proposed increasing the separation distance between wind farms and local communities from 2km to 2.5km[77].

CWIF claims that blade failure is the most common accident with wind farms, closely followed by fire. However, we do not have sufficient data for us to verify that those accidents caused harm to public and wind farm workers as a result. However we can safely say that those accidents were reported to relevant health and safety authorities for root-cause investigation and assessment to damage to environment.

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[76] http://www.hse.gov.uk/research/rrhtm/rr968.htm

[77] http://www.bbc.co.uk/news/uk-scotland-scotland-politics-26579733

A recent survey[78] by GCube, one of the main providers of insurance to renewable energy schemes, published in the US reports that the most common type of accident is blade failure, and that the two most common causes of accidents are fire and poor maintenance.

2.23.1. WTG Related Accidents

According to the data collected by CWIF, there were 1662 reported WTG related accidents worldwide in the period of 1970-2014 as shown in Table 14 below.

Year	70s	80s	90s	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
No of Accidents	1	9	98	30	17	70	66	59	71	82	124	131	131	119	166	166	165	157	1662

Table 14 – WTG Related Reported Accidents, Worldwide

Likewise according to the data collected by CWIF (see Table 15) , there were 112 fatalities caused by WTG related accidents worldwide the period of 1970-2014 as shown in table below. CWIF points out in its report that in certain incidents one accident caused more than one fatality.

According to CWIF, of the 112 fatalities 90 fatalities were among wind farm and direct support workers such as divers, construction, maintenance, engineers and 62 fatalities were among public including workers not directly dependent on the wind industry such as transport workers, aircraft passengers. For example in April 2014, a small airplane heading back to South Dakota, US crashed into a wind farm in foggy weather, killing the pilot and three passengers onboard[79]. Another accident happened in March 2012 when a bus carrying 33 passengers collided with a truck loaded with 40 ton wind turbine tower section killing 17 bus passengers in Brazil. While all reports blamed the bus driver for the accident, this is certainly an accident involving wind farm construction with the highest death toll until today[80].

Year	70s	80s	90s	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
No of Fatalities	1	8	15	3	0	1	4	4	4	5	5	11	8	7	14	14	4	4	112

Table 15 – WTG Accidents Resulting in Fatalities, Worldwide

CWIF reports that 130 accidents resulting in injury were reported in the period of 1990-2014 as shown in the table below. Of that 107 accidents caused injury among the wind farm construction/maintenance workers, and a further 23 accidents affected members of the public or workers who were not directly involved in wind farm activities such as firefighters, transportation workers.

According to CWIF, 52 WTG incidents impacting upon human health are recorded since 2012 (see Table 16). Those incidences were previously filed under "miscellaneous". Such incidents include reports of ill-heath and effects due to turbine noise, shadow flicker, etc.

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[78] http://www.gcube-insurance.com/press/gcube-top-5-us-wind-energy-insurance-claims-report/

[79] http://www.nola.com/news/index.ssf/2014/04/4_dead_after_small_plane_crash.html

[80] http://ecotretas.blogspot.co.uk/2012/05/accident-with-bus-and-wind-tower-on.html?utm_source=twitterfeed&utm_medium=twitter

Year	70s	80s	90s	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
No. of Injuries			5	4	1	2	2	2	6	10	16	16	9	14	12	15	9	7	130
No. of Incidents Impacting Health																6	27	19	52

Table 16 – WTG Accidents Resulting in Injuries and Health Problems, Worldwide

2.23.2. Rotor Blade Accidents

CWIF reports that by far the biggest number of incidents was caused by rotor blade failure. Rotor blade failure can arise from a number of possible root-causes and may result in pieces of blade being thrown away from a WTG or structural collapse of a WTG. According to CWIF, a total of 309 separate rotor blade incidences reported in the period of 1900–2014 as shown in Table 17. CWIF report states that rotor blade pieces are documented as travelling up to one mile. In Germany, rotor blade pieces have gone through the roofs and walls of nearby buildings. This is why CWIF report recommends a minimum distance of at least 2km between WTG and occupied housing in order to address public safety and other issues including noise and shadow flicker.

Year	70s	80s	90s	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
No of Blade Accidents			35	4	6	15	13	15	12	16	22	20	26	20	19	28	30	28	309

Table 17 – Rotor Blade Accidents, Worldwide

2.23.3. Fire Related Accidents

According to CWIF, fire is the second most common accident cause in wind farms. This statement may be true for the operational phase of OWFs and ONWF, but certainly fire is not the second most common accident during the construction phase of wind farms. CWIF report states that 241 WTG fire incidents, which can arise from a number of sources (some turbine types seem more prone to fire than others), were reported in the period of 1990-2014 as shown in Table 18. The biggest problem with WTG fires is linked to the turbine height in terms of putting off a fire, as the fire brigade can do little but watch it burn itself out. While this may be acceptable in reasonably still conditions, in a high-wind or storm it means burning debris being scattered over a wide area, with consequences. In dry weather there is also fire risk, especially for those constructed in or close to forest areas and/or close to housing.

Year	70s	80s	90s	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
No of WTG Fires			6	3	2	24	17	15	14	12	21	17	17	13	20	19	23	18	241

Table 18 – WTG Accidents caused by Fire, Worldwide

2.23.4. Structural Failure Related Accidents

CWIF report states that from the data they obtained, structural failure is the third most common accident cause in operational wind farms, with 157 accidents reported in the period of 1980-2014 as shown in Table 19. Structural failure is considered to be major component failure under conditions which components should be designed to withstand for a specified number of years. While WTG design life mainly concerns storm damage to WTGs and tower collapse, practices such as design error, manufacturing defects, poor quality control during installation and inadequate maintenance practices may cause WTG component failure. Although structural failure is far more damaging and more costly to the asset owner than blade failure, the accident consequences and safety risks to human are lower, as typically WTGs are not manned and impact of collapse of a WTG will be confined within the wind farm zone.

Year	70s	80s	90s	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
No of Structural Failures		1	14	9	3	9	7	4	7	9	13	9	16	9	11	10	14	12	157

Table 19 – WTG Accidents caused by Structural Failures, Worldwide

2.23.5. Ice Throw Related Accidents

According to CWIF there are 35 ice throw incidents reported to local authorities in the period of 1990-2014 as shown in Table 20. CWIF reports that any injury caused by ice throw is reported within the Table 16 – WTG Accidents Resulting in Injuries and Health Problems, Worldwide. It is reported that one of the ice throw incident involved a throw range of 140 meter. Some Canadian wind farm sites have warning signs posted asking people to stay at least 305 meter from turbines during icy conditions.

Year	70s	80s	90s	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
No. of Ice Throw Incidents			9	0	0	2	2	4	4	3	0	3	4	1	1	1	0	1	35

Table 20 – WTG Accidents caused by Ice Throw, Worldwide

2.23.6. Transportation Related Accidents

According to CWIF, there have been 137 reported transport accidents in the period of 2002-2014 as shown in Table 21. While one of the transportation accidents involved a 45 meter tower section ramming through a house while being transported, another accident occurred when WTG transporter knocked a utility pole through a restaurant. The statistics recorded in the table below only include accidents without injuries and fatalities as those statistics are included in the respective sections above. While most transportation accidents involve WTG components falling from trucks onshore, there are also transportation accidents offshore where a number of WTG components reported to be dropped into the sea during transportation/installation along with a £50 million barge (carried subsea cables) overturning. Transport accidents are reported to be the single biggest cause of public fatalities.

Year	70s	80s	90s	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
No. of Transportation Accidents						4		3	6	6	19	10	11	11	24	17	9	17	137

Table 21 – Wind Farm Component Transportation Accidents, Worldwide

2.23.7. Environmental Accidents

CWIF reports that 162 environmental accidents (including bird deaths) were reported in the period of 1990-2014 as shown in Table 22. According to CWIF, increased number of environmental accidents reported since 2007 can be attributed to the changes in legislation or new reporting requirements in countries where wind farms are built. The accidents reported all involved either damage to the wind farm site or caused damage to the wildlife, which includes death of protected bird species. CWIF reports that 2,400 protected golden eagles and about 10,000 protected raptors have been killed at the Altamont Pass Wind Farm in 20 years in California; in Germany, 32 protected white tailed eagles were found dead on a wind farm site; in Australia, 22 critically endangered Tasmanian eagles died after hitting WTGs at Woolnorth Wind Farm.

Year	70s	80s	90s	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
No. of Environmental Accidents			1	0	1	1	8	1	6	5	10	21	13	19	20	20	16	20	162

Table 22 – Wind Farm Environmental Accidents, Worldwide

2.23.8. Other Accidents

CWIF reports that 327 other miscellaneous accidents have been reported in the period of 1990-2014 as shown in Table 23. These statistics includes component failure with no consequential structural damage, lack of maintenance, electrical failure with no injury and fire consequence, lightning strikes with no blade damage or fire consequence, construction/construction support accidents and other accidents, which could not be include in other categories.

Year	70s	80s	90s	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
No. of Other WTG Accidents			13	7	4	12	13	11	12	16	18	24	27	25	43	36	33	33	327

Table 23 – Other WTG Accidents, Worldwide

Although we have relatively sufficient information about the WTG component failure data, we do not have access to detailed accident information, which is needed to link the reported accidents to WTG component failures for verification of the type of reported accidents. Therefore, it should be noted that the statistics included in this section of the study may not represent the actual number of reported accidents caused by particular WTG component failures.

It is recommended for BSEE to enforce a robust accident reporting system that documents accidents and near-miss events within offshore and onshore wind sector, as there is a genuine need for accident records to be collected, monitored and assessed in the process of improving safety performance of the wind energy industry. At minimum the data on following incidents that should be collected:

a. Fatal accident
b. Serious injury caused by accidents such as fall from heights, electrocution, transportation, installation, boat landing
c. Vessel collision
d. Helicopter crash
e. Diving accidents
f. Near-miss event including near vessel collision, helicopter misses
g. Evacuation of personnel in response to non-weather-related events
h. Release of hazardous chemicals to soil and ocean
i. Electrical failure incidents or lightning incidents resulting in fire
j. Incidents involving ice throw, rotor blade throw, structural failure resulting in collapse of WTG.

2.24. Near-Miss Event Tracking

In this section we shall address whether wind farm operators track or report near-miss events and what events are tracked. The near miss event is an unplanned event that does not result in physical injury or cause lost time at work. An example for such event, while inspecting a rotor blade via rope access in an ONWF inspector drops a heavy object, which just misses a contractor working on the wind farm site. In this scenario, no one gets injured and everyone carries on with their works.

A number of health and safety guidelines issued by wind energy associations including Renewable UK, Irish Wind Energy Association, European Wind Energy Association all require near miss events to be recorded and assess for prevention of event taking place again. RenewableUK states within its Offshore and Onshore H&S Guidelines that "*To be safe an Organization has to learn, particularly from errors and near misses, which need to be reported and investigated, with effective preventive actions being followed through and to report, staff need to know that they will not be blamed and punished for genuine human errors or "honest mistakes" and that their reports will be used for Organization al learning and safety improvement; however, everyone should remain accountable for their actions, and the line between acceptable behavior, where honest mistakes are tolerated, and unacceptable behavior (such as serious deliberate violations) needs to be defined clearly, and understood by all, in order to establish a "just" safety culture*"[81].

Irish Wind Energy Association recommends that "From the outset that a document control and record keeping procedure is established, and arrangements made for the storage, retrieval and maintenance of the records for their required retention period. Typical project documentation will include H&S management system procedures and documentation, pre-construction information, preliminary and construction stage plans, drawings and specifications, electrical systems status records, minutes of project meetings, project reports, method statements, risk assessments, work permits and associated documentation, safety incident records including **Near-Misses**, **Good Catches**, dangerous occurrences

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[81] Onshore Wind Health & Safety Guidelines, page 37, RenewableUK, http://www.renewableuk.com/en/publications/index.cfm/Onshore-Wind-Health-and-Safety-Guidelines and Onshore Wind Health & Safety Guidelines, page 35 http://www.renewableuk.com/en/publications/index.cfm/2013-03-13-hs-guidelines-offshore-wind-marine-energy

and injuries, chemical agent risk assessments or COSHH assessments and health surveillance records, test and commissioning reports, training records and certification, equipment certification, daily personnel attendance records and post-construction surveys"[82].

We observe different ways of near miss event tracking in the offshore and onshore wind energy industry. While some companies still use traditional, manually raised near miss reporting and tracking system, some companies use electronic reporting and tracking system. No matter which system is in use, it is vital that all employees and contractors, who work in a wind farm project or in a operational wind farm, should always be encouraged to communicate all near miss events promptly. Therefore following communication methods should be followed to enable them to report any near miss events:

a. Open Door Policy: Wind farm owner/operator should support informal communications through its open door policy with management. This policy is to encourage personnel and contractors to report health and safety concerns without fear of reprisal.
b. Hazard Reporting: Personnel and contractors should be encouraged to report workplace hazards or near misses as per companies' health and safety manuals, where possible via electronic near miss/unsafe working conditions report, or directly to the supervisor or SHE manager.
c. Electronic Communications: Health and safety information should be distributed via email and in companies' intranet sites.

As we addressed at the beginning of this section, a near-miss is an event that under different circumstances can result in harm to people, damage to asset or loss of production. Although it is most undesirable, a near-miss is an opportunity to learn lessons without injury, environmental incident and damage to asset integrity. Therefore, learning from a near-miss and implementing the lessons learnt can help avoid further incidents.

A near-miss is similar to an accident and therefore it should be investigated as thoroughly as an accident, therefore ensuring a successful system which in turn will reduce accidents and loss. Progress to prevent injuries can only be made if near-miss incidents are reported and corrective actions are put in place to prevent re-occurrence. Personnel or contractors are encouraged to give their full details as anonymous forms are of limited use in the incident investigation process. Implementing a fair and constructive approach to addressing near-miss events provides an opportunity for all staff to contribute.

2.24.1. Responsibilities

Once a near-miss has been received, SHE manager or team leader should attend the following tasks:

a. Take immediate action as required
b. Investigate the near-miss report within 3 working days

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[82]Health and Safety Guidelines for the Onshore Wind Industry , pages 55-56, Irish Wind Energy Association, http://www.iwea.com/contentfiles/Onshore%20Wind%20Guidelines.pdf

c. Inform the line manager of the near-miss and of any actions taken
d. Complete the near-miss report with proposed actions and completion dates
e. Forward a copy of the near-miss report to relevant SHE advisor and line manager
f. Update the person who raised the near-miss with progress
g. Name persons responsible for actions and discuss implementation
h. Update progress to relevant SHE advisor and line manager
i. Where relevant, arrange for near-miss to be communicated via e-mails, notice board displays, tool-box talks or team briefing

On receipt of the near-miss report, where applicable, the health and safety advisor should attend the following tasks:

a. Log near-miss on SHE tracking system database
b. Assist in the investigation, where required
c. Monitor corrective actions and enter into the SHE tracking system until completion
d. If necessary, make arrangements for the near-miss to be discussed in monthly safety meetings, posted on the notice boards and circulated to other business units.

Near-miss investigations may require participation from a higher level (possible Panel of Inquiry depending on severity of actions required) when there is a potential for a major accident or loss or where it would be unfair to ask the SHE manager or team leader to solve problems beyond their work scope Occasionally circumstances cross into other managers' areas of responsibility – the investigation should then include a section manager from this area. Another typical situation is when the remedial actions have a broad scope or significant costs, in such cases it may be necessary for the manager to be consulted to develop the most effective way forward.

However, in all situations the SHE manager and team leader should be included in the investigation to capitalize on their knowledge and experience.

2.24.2. Near-Miss Events Reporting

The near-miss report form should be completed providing all available details with documented information such as photographs, drawings or sketches and any information regarded as relevant to assist the investigation. The form must be forwarded to the SHE manager or team leader, who is responsible for arranging near-miss investigation. Staff members or contractors should make effort to take appropriate action to rectify or minimize any risk whenever practically and physically possible even before any near-miss report is produced.

2.24.3. Near-Miss Events Investigation

All Near Miss reports, incidents and accidents must be investigated thoroughly. Depending upon the significance of the near-miss event, a local investigation should be carried out by the team leader or supervisor to determine the root-cause. The team leader or supervisor should use the accident reporting and investigation form to initiate the investigation of near-miss. Investigations should result in the identification of basic causation, suitable recommendations to prevent recurrence and the findings and recommendations prepared for communication to employees.

After completion this investigation process the team leader or the supervisor should make the recommendations in the accident form, which needs to be agreed with the health and safety manager, the department manager and person who was subject to near-miss. Time scales for implementation of the recommendations should be set and agreed by all parties and the accident form, containing sufficient information about the near miss event, should be signed off by health and safety manager, department manager, and the team leader or the supervisor. Completion of each recommendation should be monitored using the electronic accident recording system, where applicable.

2.24.4. Near-Miss Event Tracking System

Following an investigation and before the near-miss event can be closed off, the findings must be communicated to the relevant staff. The SHE manager should enter all actions and timescales set from the near-miss investigation onto company's SHE tracking system in order to track the progress of the near-miss report through to completion. The SHE department should also provide a monthly report of all the outstanding action as part of the safety performance monitoring process. All recommendations and findings must be communicated to staff and contractors as appropriate. This may be carried out by using safety meetings, team briefings or holding an extraordinary meeting to present the findings and to discuss the implementation of the recommendations.

2.24.5. Near-Miss Event Recording

The team leader or the supervisor should ensure that the details of the near-miss event are entered into the accident log book. This is a legal requirement under the relevant regulations in countries such as the UK, Ireland, Denmark and Germany. The original accident form containing near-miss incident should be forwarded to appropriate department nominated person for logging into the electronic accident recording system, where applicable, within four days from the date of the near miss event taking place. Copies of the completed accident form should be forwarded to the local health and safety officer and the trade union appointed safety representative, where applicable.

It is recommended for BSEE to assign HSE auditors to audit OWF and ONWF owners and operators periodically to monitor the near-miss event tracking practices.

2.25. Identification of BAST

In this section we address whether the wind industry have means of identifying and/or requiring the use of best available and safest technologies (BAST).

A number of authorities and independent organizations have set up processes to record and evaluate accidents, incidents and near-miss events either caused by failure in wind farm components as a result of mechanical, electrical or structural problems or by human error in wind energy industry worldwide. Some of those authorities are also involved in the consenting process when an OWF or ONWF project goes through consent approval process. For example, UK Marine Coastguard Agency (MCA) is one of the authorities in the UK which reviews proposed OWF plans to assess whether the proposed OWF development presents risk to navigational safety in the UK territorial waters.

As the wind energy technology has started to mature over the years, a number of technology-related risks have been identified and addressed. While it is a legal requirement to carry out wind farm design risk assessment in the UK, Germany and Denmark, it is also a common practice in other European countries to apply design risk assessment throughout the front-end-engineering-design and detailed design phases of an OWF project. The selection of best available and safest technology for OWF components are based on site conditions (including wind, water depth, currents, soil conditions, climatic conditions and earthquake topography), consent requirements (including wildlife, aviation safety, navigation safety and defense) and other regulatory requirements. While all OWF projects go through design risk assessments to ensure that wind farm components, including WTGs, TPs, substructures, OSPs and Met-Masts, are designed to operate safely with structural integrity intact during the full design life, which is typically 25 years, the relevant authorities in Denmark, Germany and US require OWF design to be reviewed and approved by a third party under so called project certification process[83]. The main driver behind the third party verification of an OWF project is to ensure that the asset will not present safety risk while in operation. For example, Bundesamt für Seeschifffahrt und Hydrographie (BSH) requires OWF owners to appoint a third party project certification body to ensure that OWF will not impair the safety and efficiency of navigation and it will not be detrimental to the marine environment.

2.25.1. Wind Turbine Safety Rules

There are several initiatives to help wind energy industry gather information in order to determine best available and safest technologies and practices particularly in offshore wind energy field. One of those initiatives has been commenced by the RenewableUK. RenewableUK has been consulting on the potential scope to develop new safety rules to support the Wind Turbine Safety Rules (WTSRs) to enable extended cover for High Voltage (HV) activities. According to Chris Streatfeild, Director of Health and Safety of RenewableUK, this was initiated in response to a review of the WTSRs which was completed at the end of 2013 with the report drawing an overall conclusion that “the Rules adequately address the main inherent dangers associated with installed LV electrical and mechanical equipment in wind turbines”. However one of the findings of the review was that some stakeholders would support an extension to cover HV electrical safety. Following consultation with the RenewableUK members and discussion with the lead RenewableUK health and safety groups a decision has been taken that at present there is insufficient support for RenewableUK to proceed with the development of new rules & guidance to extend the WTSRs to cover HV systems. The reasons behind this decision were mainly that there was no clear consensus that the potential benefits would outweigh the range of safety and operational risks (both known & unknown risks) that could arise by creating a new HV Rules Set. It is also

[83] This task is carried by Certified Verification Agent (CVA) in the US.

noted that there are currently well developed and proven processes available for the safe management of HV activity within the UK power industry and these are currently in wide use across the wind industry which can be taken into account by competent persons familiar with their scope and application. According to Renewable UK, while this project will not at present be taken forward, it is still self-evident that the risk profile of at least part of the industry is changing - due to size & design of WTGs mainly but not necessarily only offshore wind projects - and there is likely to be an increase in HV equipment within towers and nacelles. Therefore RenewableUK states that in view of this, duty holders will still need to ensure that effective safe systems of work and the appointment of competent persons are properly addressed taking account “accepted” HV Rules while also addressing the specific WTG/HV configuration. In taking this into account, RenewableUK has agreed that the primary focus for 2015 should be the consolidation and effective communication of the WTSR revision3 “Package” which is so well embedded across the industry. However this would be supported by the development of some high level options that may be suitable to address the HV situations relevant to wind energy industry, and identification of the factors to consider when deciding on an approach. Final timelines are yet to be agreed but RenewableUK expects to be able to announce the finalization and release of the WTSR v3: 2014/5 “Package” (Updated Rules & procedures: Improved Formatting: New Training Standard) in Q1 of 2015.

Wind Turbine Safety Rules (WTSR) document is perhaps the most comprehensive document that incorporates the best available and safest methods and technologies. RenewableUK considers that when implemented correctly and appropriately the Wind Turbine Safety Rules will:

a. Represent industry good practice for safeguarding employees from the inherent dangers that exist from installed electrical and mechanical equipment in wind turbines.
b. Assist in the development and application of safe systems of work in a consistent manner.
c. Provide a robust approach to demonstrating legal compliance with relevant health and safety regulations.

Prior to the implementation or revision of the WTSRs into an organization’s own health and safety management systems (or if operated as a standalone system), RenewableUK strongly advises that the WTSRs and all the supporting guidance are fully taken into account by a competent person in order to ensure that the WTSRs are implemented correctly and appropriately and that are suitable for any particular set of circumstances. As recommended by RenewableUK, it is essential that the final structure, content and format of any rules applied which incorporate any part of the WTSRs are overseen and signed off by a suitable professionally qualified competent person familiar not only with WTSRs but also their practical application taking into account site and turbine specific arrangements and all other relevant circumstances[84].

2.25.2. Renewable Industry Safety Exchange

While RenewableUK is leading WTSRs initiative, it also commenced a separate one focusing on safety benchmarking and safety alerts. The RenewableUK Board has reaffirmed its commitment to health and

[84] WTSR-002- 3rd Edition v1, RenewableUK, 2011

safety in support of their vision "to be a leading enabler in the delivery of an expanding UK wind, wave and tidal sector free of fatalities, injuries and work related ill-health" through endorsing progress in producing industry KPIs. This has resulted in the launch of the industries' new incident reporting scheme "the Renewable Industry Safety Exchange" (RISE). RISE is a sector-led initiative that aims to facilitate the collation, sharing and dissemination of health and safety incidents, events and emerging industry learning and good practice for the mutual benefit of all stakeholders working in the renewable energy sector. RISE seeks to support an industry committed to the highest standards of health and safety and a collective undertaking to continually improve in health and safety performance. RISE allows the users to:

a. lodge, review and analyze incidents from their activities within a secure system,
b. compare their performance against industry peers and the wider renewable industry,
c. access lessons learnt, suggestions for improvement and key performance indicators of progress,
d. generate/share safety alerts and receive targeted health and safety news and
e. support and enhance the health and safety position and reputation of the industry.

Participation in RISE is open to all RenewableUK Members operating across the whole supply chain. Members can register with the scheme via www.renewablesafety.org. The site is confidential and secure, conforming to recognized IT and website security standards[85].

2.25.3. The Carbon Trust

The Carbon Trust is another stakeholder in wind energy industry that also started new initiatives called "the Offshore Wind Accelerator" (OWA). Although this initiative is mainly focused on cost reduction in offshore wind sector, the search for best available and safest technologies is integral and important part of the initiative. OWA is Carbon Trust's flagship collaborative research, development & demonstration program. Set up in 2008, the OWA is a joint industry project, involving nine offshore wind developers (DONG Energy, E.ON, Mainstream Renewable Power, RWE Innogy, Iberdrola, SSE Renewables, Statkraft, Statoil and Vattenfall) with 72% (31GW) of the UK's licensed capacity that aims to reduce the cost of offshore wind by 10% by 2015. Technology challenges are identified and prioritized by the OWA members based on the likely savings and the potential for the OWA to influence the outcomes. OWA projects are carried out to address these challenges, often using international competitions to inspire innovation and identify the best new ideas. The most promising concepts are developed, de-risked and commercialized as the OWA works closely with the supply chain throughout the process. The OWA model brings together Carbon Trust's expertise in delivering innovation and convening industry consortiums with the industrial partners' technical knowledge and resources. The OWA is two-thirds funded by industry and one-third funded by the UK Department of Energy and Climate Change (DECC)[86].

The OWA Research Development & Demonstration programme is focusing on five areas:

[85] http://www.renewableuk.com/en/our-work/health-and-safety/incidents--alerts.cfm

[86] http://www.carbontrust.com/our-clients/o/offshore-wind-accelerator

a. Foundations: Developing new turbine foundation designs for 30-60m water depths that are cheaper to fabricate and install.
b. Access systems: Developing improved access systems to transfer technicians and equipment onto turbines for operations and maintenance in heavier seas.
c. Wake effects: Improving the layout of large wind farms to reduce wake effects and optimize yields.
d. Electrical systems: Developing new electrical systems to reduce transmission losses and increase reliability.
e. Cable installation: Improving cable installation methods.

These research areas were chosen as they represented the greatest potential for reducing the total cost of constructing, operating, and financing large offshore wind farms. The derivative benefit of those research programs is the improvement in safety aspect of the new technology/new solution in offshore wind energy industry, as each research takes into account the safety aspect of the new design or new installation techniques when assessing the viability of each innovative solution.

2.25.4. Offshore Wind Acceleration Research – Access Systems

The OWA research on "access systems" is particularly focused on safety and best practices. The offshore transfer of personnel and equipment is one of the riskiest activities of an OWF operation and maintenance phase as a number of incidents has taken place during offshore transfer, which also involves boat landing. Boat landing is not only a high risk activity in terms of safe transfer of personnel from a vessel to offshore WTG, but also it presents risk to structural integrity of the turbine with crash-impact generated during the approach of a vessel to an offshore WTG, unless the boat is purpose built to reduce the safety risk and crash-impact risk on WTG.

The research was initiated following a competition program. The Carbon Trust Offshore Wind Accelerator Access Competition aimed to identify and develop new access systems to dramatically improve the availability of WTGs and the safety of people during the transfer to WTGs offshore[87]. The competition shortlisted the following designs in three categories:

a. Vessels: Vessels for transporting personnel and equipment from bases or mother ships to turbines, incorporating a transfer system. 6 new designs were shortlisted for best vessel technology in this category.
   TranSPAR Craft: According to the designer, the TranSPAR Craft (see Figure 5) is a radically different type of craft when compared to current access vessel design. An extremely small water plane area, coupled with a fin keel arrangement similar to that found on high performance sailing yachts, has resulted in a very stable transfer vessel especially well-suited for operations in

[87] Offshore Wind Accelerator Access Competition - Shortlisted Designs, The Carbon Trust, London, 2010, http://www.carbontrust.com/media/105306/owa-access-innovators.pdf

high sea states. While it may not be the fastest vessel in kind, the TranSPAR Craft's speed has been optimized for service operations staged from a central hub to meet the in-field service requirements of deep water offshore wind farms. Anticipated to be cost-effective from both a manufacturing and operations perspective, the TranSPAR Craft could dramatically change the approach to offshore personnel transfer and wind farm service strategies.

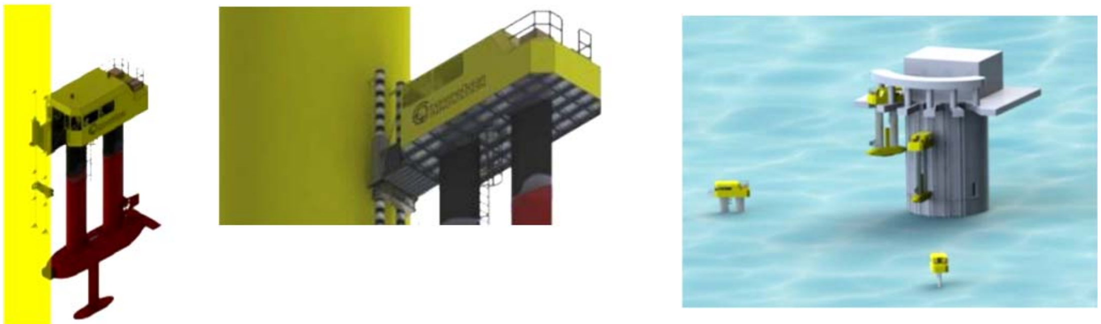

Figure 5 - TranSPAR Craft Design

WindServer: According to the designer, the Fjellstrand WindServer's (see Figure 6) innovative hull design allows very fuel-efficient travel within the wind farm, but unlike other fuel-efficient vessels, it is actually very stable, hence safe, when stationary which is ideal for transferring engineers to turbines. The slender waterlines and unique bow ensures minimized motion at high speeds as well as during low speed maneuvering around the offshore wind farm. The generous deck space made possible by the hull's ample load capacity can accommodate practically any transfer system.

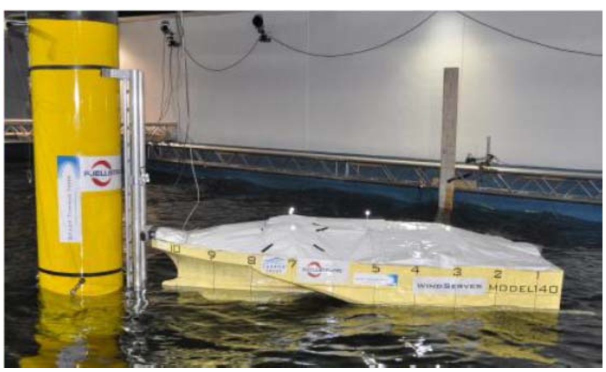

Figure 6 – WindServer Design

Nauti-Craft: According to the designer, Nauti-Craft (see Figure 7) is a radical new vessel design unlike anything else in the maritime engineering industry. The vessel's hulls are separated from the deck and superstructure via a 'passive reactive' hydraulic suspension system. This technology draws on the Nauti-Craft team's experience in the development of interconnected suspension systems used by winning Dakar and WRC rally cars as well as many production motor vehicles including McLaren's new road car. The Nauti-Craft system allows the hulls to conform to the ocean's surface while providing improved stability and safety of the deck for crew transfers. The suspension also reduces structural loadings whilst increasing passenger comfort and fuel efficiency, permitting greater speed to the work location.

Figure 7 - Nauti-Craft Design

Pivoting Deck Vessel: According to the designer, the Pivoting Deck Vessel (see Figure 8) concept incorporates a deck into the vessel, which links with the turbine foundation and reduces motion significantly during transfers. It also allows heavier equipment to be transferred compared too many competing systems, which means that the vessel can be used for more O&M operations.

Figure 8 - Pivoting Deck Vessel Design

SolidSea: Robert MacDonald, a student from the University of Strathclyde, is developing a concept for an innovative access vessel for offshore wind turbines. This novel vessel configuration aims to fulfil two distinctly different services; firstly, to provide fast and comfortable transit for personnel and equipment to and from offshore wind farm sites; and secondly, to provide a safe, stable and static transfer platform on arrival at the turbine base in sea-states above that tolerated by present vessels. The vessel’s design means the configuration can be changed at sea to accommodate these two different circumstances allowing maximum potential to be provided in both situations. The concept is at an early stage in the design process and this feasibility study will investigate the vessel configuration and confirm its application in the onerous conditions encountered by the offshore wind industry.

Surface Effect Ship: The Surface Effect Ship (see **Error! Reference source not found.**) design has been adapted from vessels used by the Royal Norwegian Navy as Mine Counter Measure Vessels and Littoral

Combat Crafts. Using an air-

Figure 9 – Surface Effect Ship

cushion, like a hovercraft, it moves extremely fast so it can reach a turbine in a shorter weather window than otherwise would be possible with other vessels. When stationary, the air-cushion can be used to stabilize the motions of the vessel. The air cushion provides 80% of the lift with 20% coming from buoyancy. With a limited area of the hull in the water and the air cushion, the impact of waves on vessel motions is significantly reduced.

b. Transfer systems: Transfer of personnel and equipment from vessel to turbine, potentially with motion-compensation.
   Autobrow: According to the designer, it is an elegant and simple modular transfer system, that is light weight and flexible. The Autobrow (see Figure 10) works by having a gangway, or brow, automatically controlled up and down to compensate for the heave and pitch of the vessel. The tower end of the brow automatically extends to ensure firm contact at all times. The low cost system provides a significant improvement in transfer safety and operating window. The Autobrow is being developed by Otso Ltd and designed by Ad Hoc Marine Designs Ltd.

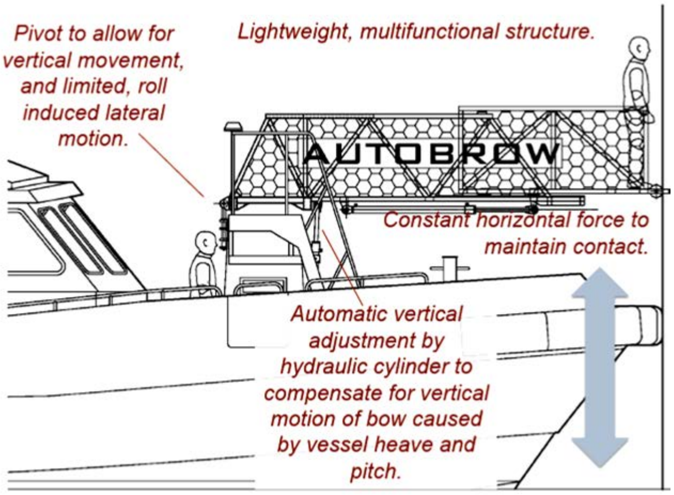

Figure 10 – Autobrow Design

BMT & Houlder Turbine Access System (TAS) Mark II: According to the designer, this transfer system is a development of the award- winning TAS® system, developed by Houlder with BMT Nigel Gee, for which sea trials are planned this autumn. The light design can be fitted to smaller vessels to deliver a more cost effective solution than that achieved by larger dynamically positioned boats carrying complex transfer platforms (see Figure 11).

Figure 11 – BMT & Houlder Turbine Access System Design

Momac Offshore Transfer System (MOTS): According to the designer, its innovative robot arm uses sensors to measure the motions of the vessel and compensates by adjusting the position of the arm to keep the transfer platform stable. The design is currently undergoing prototype testing. The concept has significant potential to be used for a variety of operation and maintenance activities.

Wind Bridge: According to the designer, Wind Bridge (see Figure 12) is a pneumatic-based boarding bridge for access to boat landings on offshore wind turbines from a service vessel featuring an impact absorbing boarding system and dynamic heave compensation. Once contact is made, an automated retention clamp system is activated forming a safe access. The Wind Bridge will be clamped to the boat landing of the wind turbines foundation resulting in a rigidly connected embarkation point which greatly improves operability in higher sea states.

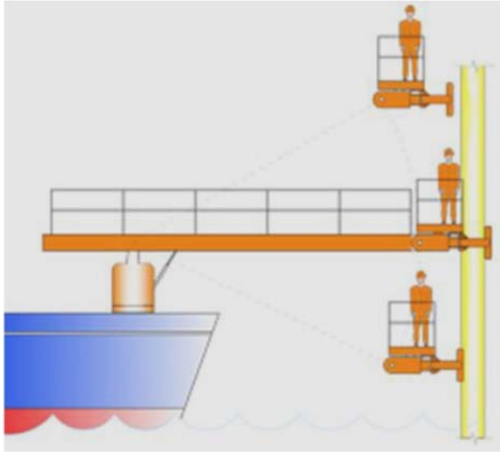

Figure 12 – Wind Bridge Design

c. Launch and recovery systems: Systems fitted to the permanent bases or mother ships for launching and recovering daughter craft from the sea.
   Divex LARS: Adapting principles from the diving industry, Divex (see Figure 13) have designed a launch and recovery system (LARS) that uses a semi-submersible cradle that can be lowered

from the stern of the mother ship to launch and retrieve daughter craft. The inclination of the cradle is automatically adjusted so that it acts like a ramp when retrieving the daughter craft, significantly reducing the complexity and risk compared to existing launch and recovery systems. The design allows launch and recovery in rougher seas with both a stationary and moving mother ship as the cradle synchronizes with the wave motion.

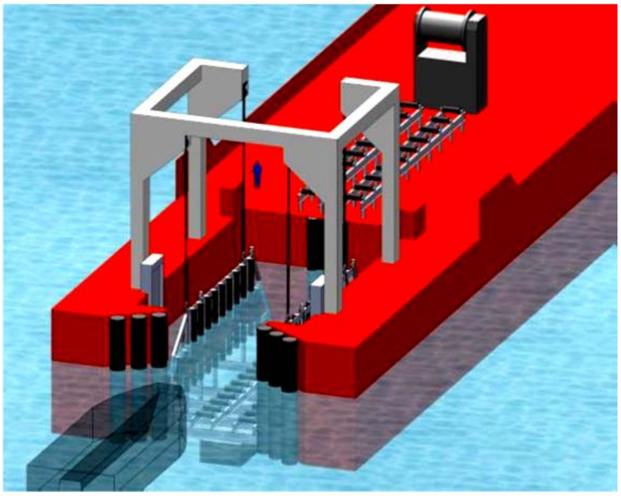

Figure 13 – Divex Launch and Recovery System Design

Offshore Kinetics Launch & Recovery System: Offshore Kinetics (see Figure 14) is developing a complete maintenance system for offshore wind farms, consisting of mother ship, service vessels and personnel facilities. As a part of this concept, Offshore Kinetics has designed a lift system to launch and recover daughter crafts from the mother ship, and to move the daughter crafts around the deck so that a number of vessels can be operated from a single mother vessel.

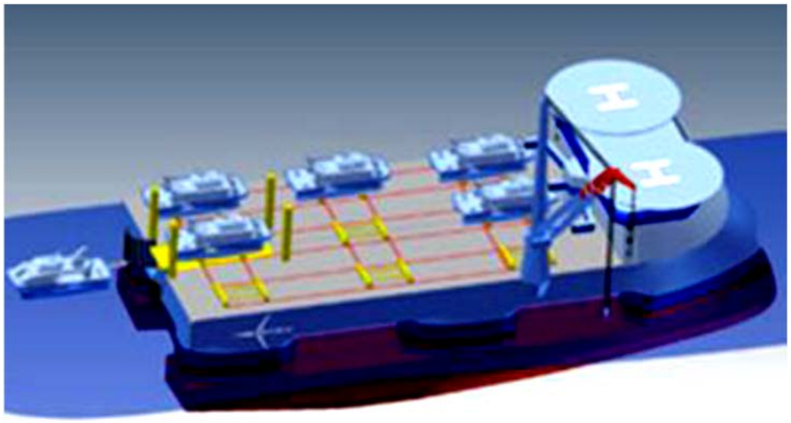

Figure 14 – Offshore Kinetics Launch & Recovery System Design

Z Port: The Z Port (see Figure 15) is a mother ship that remains permanently at sea at the offshore wind farm zone, accommodating the crew and operation and maintenance technicians and deploying a number of in-field daughter craft. Z Port creates a sheltered harbor area of 85 by 15 meters to protect daughter craft from the waves, which means vessels can be launched and recovered in high sea states.

Towing tank tests show a reduction of 80% of wave height in the harbor compared to actual sea state outside the harbor.

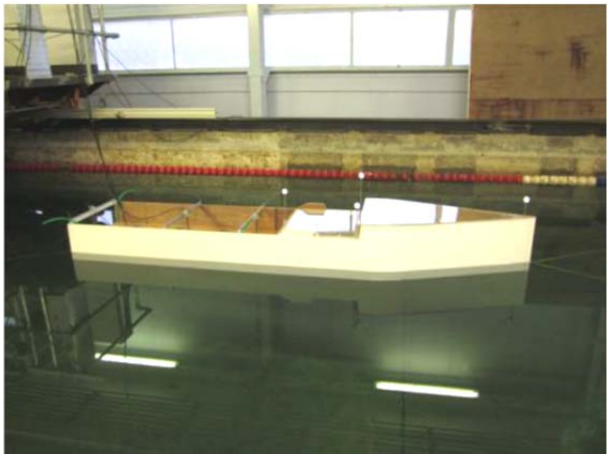

Figure 15 – Z Port Design

Since the competition in 2010, technical experts from the 8 OWA partners and the Carbon Trust have been working with these innovators to de-risk and commercialize the design of technology.

2.25.5. Design, Construction, O&M and Decommissioning

In this summary section, we compile best available and safest methods and technologies which are typically implemented for the design, construction, operation & maintenance and decommissioning of OWF projects. The design parameters for the main elements of an OWF project cover foundation, transition piece, WTG, Met-Mast, offshore electrical infrastructure including OSP, inter-array cables, export cable and onshore electrical infrastructure including export cable landing and the onshore substation. A typical OWF project should ensure that the following aspects of the wind farm design, construction, operation & maintenance and decommissioning activities are taken into account to ensure operational safety of OWF:

a. **Layout**: WTG layout within a project site should be designed and constructed to satisfy the safety requirements of the national maritime and coastguard agency.
b. **Visibility**: Marking, lighting and fog-horn specifications must meet the requirements of national civil aviation authority and national lighthouse authority.
c. **Electrical**: Main electrical equipment, within WTG and the offshore substation electrical equipment, which includes a number of ancillary systems such as heating, ventilation and air conditioning, control and protection system, batteries, battery chargers and uninterruptible power supply (UPS) and a fire suppression system must meet applicable statutory safety requirements.
d. **Safety Zones**: Determine safety zones around the WTGs, Met-Mast, foundations, OSP, subsea cables during installation and any maintenance works offshore in accordance with applicable local regulations. For construction purposes, a safety zone with a radius of 500 meter from the construction vessel should be applied; this rule should also be used for major maintenance vessel works in the operational phase of an OWF. In addition that, safety zones should also be

implemented around each of WTG and its foundation during the construction period only. This should have a radius of 50 meter from the outer edge of the foundation/transition piece (whichever is the larger). The safety zones should limit all non-project vessels from entering the safety zones during the construction and maintenance of an OWF.

e. **Navigation**: Navigation safety areas should be determined around the works for the duration of the shore-end operations to ensure no vessels or vehicles, which use the beach/near shore, interact with the OWF construction works.
f. **Construction Risk Assessment**: Offshore construction methodology should be put in place and risk assessed for safety of people and environment. Construction risk assessment should include the activities carried out in the following stages:
    i. Site preparation for offshore substation
    ii. Installation of offshore substation foundation
    iii. Installation of offshore substation
    iv. Site preparation for export cabling
    v. Installation of export cable
    vi. Site preparation for foundations
    vii. Foundation and transition piece installation
    viii. Site preparation for inter array cabling
    ix. Installation of inter-array cables
    x. Installation of wind turbines (on previously installed foundations)
    xi. Commissioning of wind turbines
g. **OSP**: Power generated by WTGs is transmitted by the array cables to OSP (see Figure 16), where the voltage is converted from medium voltage to high voltage for transmission of power to shore via export cable. A typical offshore substation can be divided into foundation structure, which can be suction buckets, piles or a gravity base; the substructure, which can be tubular-lattice structure, a steel jacket or concrete legs; and the topside, which is typically a box-shaped structure placed on top of the substructure and houses the electrical equipment such as the transformers, high voltage and medium voltage switchgear etc. Some OSPs include a helideck.

Figure 16 – OSP[88]

a. **Hazardous Substances**: Transformer oil is contained within the power transformers to insulate the electrical components in the topside of OSP. In addition the oil is used to transfer the heat from the active (energized) transformer parts to the transformer coolers. Each transformer, which is installed onshore before transportation to offshore site, is filled indicatively with oil. The oil-filled transformer includes an oil bunding system. This is a closed compartment designed to capture any leakages in a limited area underneath the transformer and avoid oil spillage on the floor. In case of oil spillage, spilled is collected and transferred to an oil sump tank. The level of transformer oil is constantly monitored by the control and protection system which is designed to sound an alarm if oil levels are critically low in the transformer enclosure. Diesel Fuel is another hazardous chemical contained in the service tank of the diesel generator and in storage tank installed within the topside of OSP. The diesel generators are used for back-up power supply of the OSP in case of loss of grid connection and to supply power during the installation and commissioning period. The exact amount of diesel fuel required and the need for refilling depends on the generator size and operational pattern. The fuel oil bunding system is formed as a closed compartment designed to capture any leakages in a limited area underneath the tank and avoid oil spillage on the floor. The level of diesel fuel is constantly monitored by the control and protection system which is designed to sound an alarm if fuel levels are critically low in the diesel tank[89].
b. **Foundation**: Foundation transport and installation activities should be risk assessed for safety in accordance with foundation type (monopile, gravity base, jacket, floating etc.), consent requirements, vessel capabilities, soil conditions and weather conditions for the following stages:
    i. **Sea bed preparation, where necessary**: Minimal seabed preparation will comprise of an unexploded ordnance survey, debris removal, seabed levelling (most likely by dredging) and an application of a filter layer of stones where necessary. This requirement will vary in accordance with the foundation type.
    ii. **Transport of the foundation to offshore site**: A number of methods can be used to transport foundations to offshore wind farm site including by floating out to the installation vessel, by transporting with barge where they are loaded onto an installation vessel by crane or directly by the installation vessel. The type of installation vessel/s, which can be self-propelled jack-up vessels, jack-up barges (towed by tugs), or large heavy-lift vessels, and its crane capabilities should be risk assessed for safe operations.
    iii. **Installation of the foundation**: Safest installation methodology must be determined based the foundation type and consent requirements. If the foundation type is monopile – which is made of a single steel monopile consisting of a steel tubular section

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[88] Burbo Bank Extension Offshore Wind Farm, Environmental Statement, Dong Energy, 2013

[89] Burbo Bank Extension Offshore Wind Farm, Environmental Statement, Dong Energy, 2013

and a TP which includes boat landing features such as ladders, J-tubes (through which cables connect to the seabed) and ancillary components; the TP is usually painted yellow and marked according to national maritime coastguard agency and light house guidelines - four main methods can be used to install the monopile into the seabed rock layers, the choice of which will depend on the soil conditions present at the foundation site. The MP installation options include:

- Driven only pile, which involves driving with a hydraulic hammer,
- Driven and drilled pile, which involves the 'drive-drill-drive' method where successive driving and drilling phases are used,
- Drill only pile, which involves drilling out the entire hole for the pile and subsequently grouting in the pile and,
- Vibration, which involves vibrating the pile until its final installation depth is achieved.

If the foundation type is gravity base – which is made of reinforced concrete with usually either flat-based or conical shape – is usually installed on a gravel bed with scour protection, but without a transition piece as the WTG turbine tower is bolted directly to a flange connection cast into the concrete structure.

If the foundation type is jacket - which is formed from a steel lattice construction comprising tubular steel members and welded joints, with integrated transition piece, working platform, J-tube and boat landing facilities - fixed to the seabed by piles located at each corner; an example of a four-legged jacket is shown in Figure 17 below.

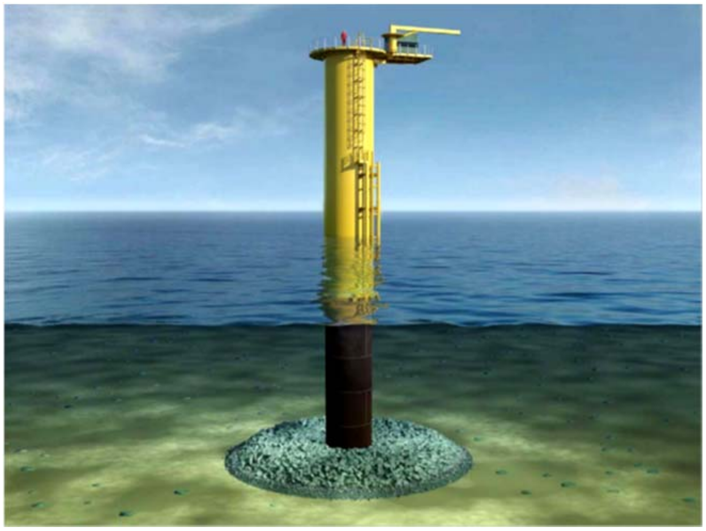
Figure 17 - Jacket Foundation[90]

[90] Burbo Bank Extension Offshore Wind Farm, Environmental Statement, Dong Energy, 2013

iv. **Installation of the Transition Piece (TP), J-tubes and Ancillary Structure**: The TP (see Figure 18) consists of a steel tube similar to the monopile with appurtenances attached such as boat landing, platforms and ladders. TP is either transported to site or a pre-assembled at the harbor (normally in an upright position) before transporting to the offshore site using transport vessels, barges or by the installation vessel itself.

Figure 18 – Transition Piece[91]

v. **Scour Protection**: Unless requisite allowances are made for scour in the design, installation of scour protection must be carried out prior to any piling activities. Scour protection is designed to prevent foundation structures being destabilized by seabed erosion and sediment process. While sand bags, stone bags mattress protection, artificial seaweeds are among the different scour protection types, the most frequently used solution is the placement of large quantities of crushed rock around the foundation base in OWFs installed in Europe. (see Figure 19)



[91] Burbo Bank Extension Offshore Wind Farm, Environmental Statement, Dong Energy, 2013

Figure 19 - MP Foundation with TP and Scour Protection[92]

c. **Diving:** Diving technique has long been used for J-Tube installation and or modification, subsea cable installation and repair, installation, monitoring and repairing the scour protection systems, replacement of anode and cathodic protection systems, under water welding inspections etc. No matter what the maintenance work or inspection task is, any diving operation at OWFs requires through preparation which involves preparation of work methods and risk assessment safety methods. A typical diving work method must address the following aspects of diving operations in order to ensure safe diving at OWF locations:
    i. Diving method statement
    ii. Valid qualifications and training certificates of personnel prior to mobilization
    iii. Safety induction and briefings at harbor before going offshore
    iv. Familiarization with the maintenance or inspection tasks
    v. Mobilisation of maintenance or inspection equipment
    vi. Mobilisation of decompression chamber with selected vessel
    vii. Function test and inspection of all diving equipment, chamber and rescue equipment
    viii. Certified lifting equipment
    ix. Checks on safe weight lifting capability of TP Davit Crane Hoist or Lift Points for equipment lifting in WTG
    x. Electrical equipment fit for purpose and tested
    xi. Availability of all emergency, rescue and radio equipment at WTG, Met-Mast or OSP, as applicable, prior to commencing any diving works
    xii. Presence of one appointed diving supervisor and at least two qualified divers, one rigger, one confined space operatives and one technician on the WTG, Met-Mast or OSP, as applicable, at all times during diving operations
    xiii. Availability of all rescue and confined space equipment prior to commencing diving works
    xiv. Approved RAMS prior to commencing diving works
    xv. Practice diver rescue from WTG, Met-Mast or OSP, as applicable, to diving vessel prior to first dive and record and review to outcome prior to commencing diving works
    xvi. Co-ordinated the diving works with diver supervisor and the technician in order to carry out safe maintenance and inspection works under water.
d. **Grouting**: After the installation of foundation (excluding gravity based foundation type) and TP, grout is pumped into the gap between the foundation and the TP and allowed to set; once it is set the bottom tower section is bolted to a flange connection on the top of the TP.
e. **WTG Installation**: Following the installation of foundation and TP, where applicable, WTGs gets installed in accordance with the installation sequence set up in advance. Using installation jack-up vessel or barge, rotor blades, nacelle and tower sections are transported to the offshore wind farm site from a preassembly harbor. While the number of WTG components loaded on a

[92] Burbo Bank Extension Offshore Wind Farm, Environmental Statement, Dong Energy, 2013

vessel depends on the WTG and the type of vessel with sea fastenings equipment and cranes, which are selected and designed for WTG installations. Installation sequence involves installation of the tower sections, the nacelle, and the rotor blades, which can be installed either one by one or as a pre-assembled complete unit. Both loading and installation of WTG components presents major safety risks. Therefore each activity requires planning, risk assessments and coordination to handle all safety risks inherent in these activities.

f. **Export Cable and Array Cables**: The Export cable (see Figure 20) transfers the power from OSP (the offshore AC substation or the offshore AC/DC converter station) to shore. Array cable (see Figure 21) connects WTG to OSP to allow the power generated at each WTG to be collected before being sent on to shore. When determining cable length the obstacles like rocks, large sand dunes, UXO, ship wrecks, areas of archaeological interest should be considered to accommodate a worst case scenario for the cable length during installation.

Subsea cables are buried in the seabed in order to reduce the risk of damage from fishing gear and anchors and prevent movement or exposure of the cables due to sediment movement or scour over the lifetime of OWF. The target burial depth is normally a trade-off between providing adequate protection and heat build-up as the deeper the subsea cable is buried, the hotter it will be during in service. Therefore it is a best practice to carry risk assessment to determine cable burial depth to achieve safe and economic cable burial works; therefore sediment mobility, seismic activity, submarine landslide, anthropogenic, dredging, aggregate extraction, subsea mining, dumping, presence of other cables, umbilical, pipelines, fishing rights, shipping routes, and exclusions such as UXO should be taken into account when determining suitable burial depths before trenching. The trenches, in which the subsea cables are laid, get excavated before the cable laying. Cable burial can be carried out by trenching, ploughing, jetting and cutting based on the soil and seabed condition.

Installation technique for the export cable and the array cable are same; however the larger size of the export cable necessitates the use of larger vessels for installation. Ideally, the array cables should be installed and commissioned before the WTGs are installed on the foundations in order to have better access to the cable deck for pull-in operations.

After installation the array cables and export cables, they get terminated at the OSP cable deck and jointed afterwards. While the export cable is normally pulled in and jointed first to energize the substation, the winches are used to pull in the array cables one at a time as the array cable installation progresses. The array cables are jointed at OSP before being energized string by string. The winches normally get removed from the substation when the cable installation is complete.

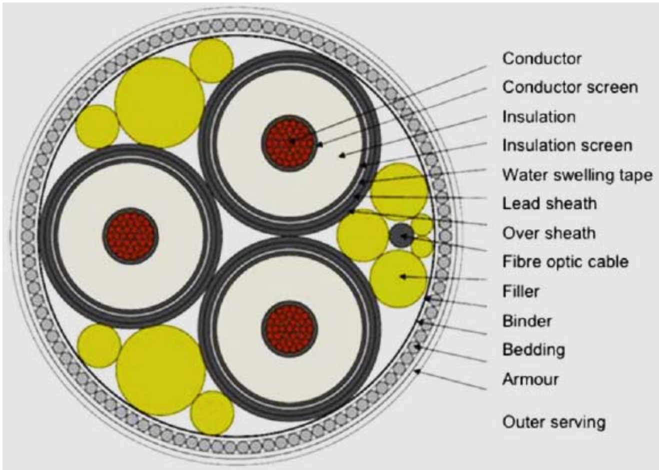


Figure 20 – Offshore Export Cable Sample (HV)[93]

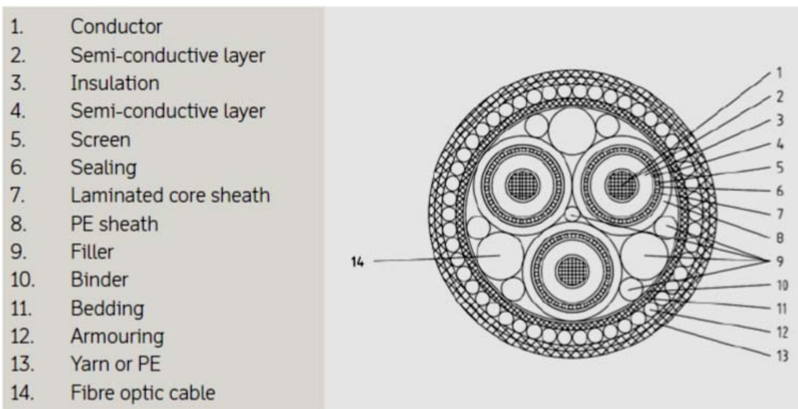


Figure 21 –Array Cable Sample[94]

g. **Sea Wall Crossing**: Export cable sea wall crossing is an important part of OWF installation phase because of the technical aspects and the environmental safety requirements, such as protection of natural habitat, set within the OWF consent document. Navigation safety areas are likely to be required around the works for the duration of the shore-end operations to ensure no vessels or vehicles which use the near shore or beach interact with the construction works.
For export cable sea wall crossing, Horizontal Direct Drilling (HDD) technique may be used at the landfall point in order to pass through sea defenses and reduce disturbance to intertidal habitats. Sea wall crossing using the HDD technique normally follows the process below[95]:

[93] Burbo Bank Extension Offshore Wind Farm, Environmental Statement, Dong Energy, 2013

[94] Burbo Bank Extension Offshore Wind Farm, Environmental Statement, Dong Energy, 2013

[95] Burbo Bank Extension Offshore Wind Farm, Environmental Statement, Dong Energy, 2013

i. An onshore drill rig drills a small diameter pilot hole along a predetermined path from the landfall transition joint bay under the sea defenses/protected habitat to a point offshore (conduit end) where the cable laying vessel can gain access.
ii. As this hole is drilled, a drilling mud (typically Bentonite) is injected into the hole behind the drilling head to ensure it is kept stable. Bentonite is an inert material consisting of a mixture of water and natural clays. The water is either transported to site in tanks or, if saltwater is used, pumped from the sea using hoses laid across the beach.
iii. A steel reamer is then pulled back through the pilot hole enlarging the diameter of the hole as it progresses. Several reaming operations may be necessary to achieve a size suitable for accommodating the size of the export cable.
iv. The depth of the drilling depends on the soil profile and the nature of obstructions to be passed. The maximum drilling depth is normally between 5 -20 meters but it may be up to 40 meters in extreme circumstances.
v. The cable ducting (usually formed from high density polyethylene) is pulled out to sea, attached to the reamer and pulled through the drilled hole and any protective casing, usually from the beach side towards the landfall. The cable duct is usually welded together prior to pulling in sections. Appropriate length of the offshore end of the export cable is shallow buried or covered by a concrete mattress in order to counter any negative buoyancy prior to commencement of cable installation.
vi. Before the cable installation vessel commences installation, the duct end should be exposed and unplugged. The cable is then pulled through the duct from a winch located at the landfall point. To ensure a smooth pull of the cable the inner diameter of the duct should be at least 2.5 times the outer diameter of the cable.
vii. Finally, the duct end and the cable inside it are re-buried into the seabed using ploughing, trenching or jetting installation techniques. The duct end is sealed with a close fitting flange before stabilization materials, such as concrete rings on the duct or concrete mattresses draped over the pipe, are installed. The duct end is usually buried to the required final depth by tracked excavators. If the duct end is above the low water mark it will usually be backfilled by these excavators as well. If the duct end if permanently submerged, it may be left to backfill naturally.
viii. Once the offshore export cable has been installed and jointed to the onshore cable, the duct is usually injected with a thermal dissipation medium - typically a proprietary thermal grout - to ensure that the cable does not overheat.

All onshore cables from the landfall to the onshore substation will be installed underground.

h. **Onshore Substation**: Onshore substation is a key component of any OWF as it converts electricity generated at the OWF to a higher voltage suitable for onward transmission to electricity transmission system. The design, layout and installation of all plant and equipment within the substation should allow operation and maintenance in accordance with all relevant statutory safety requirements. While equipment within the substation should be located a minimum of 3 meters from the fence line for security and safety reasons in accordance with technical standards such as NERC, heavy equipment such as the super grid transformer should be located adjacent to the main access road to for ease of installation.

Fire Damage Zones for equipment containing oil should be considered when producing the layout to ensure there is adequate spacing between substation components. All equipment located within the substation compound should be positioned to comply with the appropriate horizontal and vertical design clearances for the relevant voltage level. Equipment containing oil should have a bund type foundation with sufficient internal clearance at ground level between the equipment and the bund wall. All electrical plant should be located as close as possible to the NERC substation in order to minimize connection lengths.

Onshore substation should be designed to mitigate noise pollution and necessary arrangements should be made, where possible, to locate the largest noise sources away from noise receptors; if necessary the noise mitigation/suppression should be installed where necessary.

The key components of an onshore substation are transformers, reactors, harmonic filters, circuit breakers, busbars, conductors, auxiliary transformers, cables, drainage & oil containment system, and control system. Super grid transformer is used to step up the OWF transmission voltage to the required voltage such as 400kV to export the OWF power to the transmission system. Reactive compensation equipment is used to condition the OWF power prior to export to the transmission system, to ensure it complies with the requirements set out by the transmission system operator; typically, one set of reactive compensation equipment is required for each circuit connecting to the transmission system. Harmonic filters are used at the onshore substation to ensure that the power exported to the grid complies with the quality of supply requirements set out by the transmission system operator; typically, one set of harmonic filtering is required for each circuit connecting to the transmission system. In onshore substations, auxiliary transformers are used to provide a low voltage supply to the substation control buildings and auxiliary systems.

The onshore substation should have lightning protection system, permanent CCTV equipment and the external security fencing to a specified security standard for this type of installation in order to safeguard personnel and prevent unauthorized access. The onshore substation must have signage, which must be located in visible positions along the border fence in accordance with the applicable electricity supply regulations. Permanent light fittings must be installed around and within the substation. While under normal operating conditions the substation does not need to be illuminated at night, the lighting should be used only when required for maintenance outages or emergency repairs occurring at night; the lights will be directed downward, and shielded to reduce glare outside the facility. The landscaping and access road of the onshore substation site must meet consent requirements and applicable environmental regulations[96].

i. **Commissioning and Testing**: After installation of WTG cable connections, commissioning and testing takes place. This process is completed by energizing the WTG via the inter-array cables prior to putting the WTG in operation.

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[96] Rampion Offshore Wind Farm Onshore Substation Design and Access Statement, EON, 2014 http://infrastructure.planningportal.gov.uk/wp-content/ipc/uploads/projects/EN010032/2.%20Post-Submission/Application%20Documents/Reports/8.2%20Onshore%20Substation%20Design%20and%20Access%20Statement%20(FINAL).pdf

j. **O&M**: An adequate O&M set-up is required to monitor and administer the OWF's day to day activities; the objective of such set-up is to operate the OWF with optimal performance without risk to safety of workers, navigation and environment. The O&M practices include both preventive and corrective maintenance for WTG components, foundations, OSP, MetMast, offshore & onshore cables and onshore substation. While the preventive maintenance involves scheduled maintenance program or risk based inspection program, which is implemented to mitigate the risk of operational failure, the corrective maintenance covers retrofit campaigns, repairs, component replacements and re-starts after breakdowns. The O&M onshore facilities normally require an office building with adequate IT facilities for remote condition monitoring, warehouse, car parking and harbor facilities which may include berthing, pontoon and vessel fuelling facilities for the required number of crew vessels. A typical O&M strategy mainly relies on crew vessels for crew transfer, jack-up vessel for major component replacement (such as rotor blade, gearbox) and sometimes potential use of helicopters for the O&M services that will be performed at the OWF. Similar to the construction phase of OWF, O&M activities also require safety zones, such as 500 meter radius around the maintenance vessels, foundations and OSP and Met-Mast during major maintenance works, to be identified and approved by the relevant authorities. In addition, the OWF owner/operator may issue notice to mariners advising advisory safety zones to accommodate vessels with larger anchor spreads and major maintenance works to cables[97]. The maintenance and inspection requirements for OWF components are addressed separately in the relevant sections of this document; therefore we briefly address the most critical component maintenance requirements in this section.

    i. **Foundation and Transition Piece**: The foundation structures, including paint coating, are designed to maintain asset integrity during their design life such as 20 or 25 years. However, preventative and corrective maintenance procedures should be put in place for the foundations and transition pieces, where applicable, to ensure that requisite maintenance practices are carried out to maintain the structural integrity of foundations in accordance with the maintenance requirements of the designer/manufacturer of the structures.

Preventive maintenance program should include a combination of routine inspections of the substructure and TP, along with inspections in confined space, such as below the airtight deck of an MP foundation, for which qualified technicians and specialized equipment may be required. It is highly recommended to implement preventive maintenance using vessels to access the foundations and ROV to carry out subsea inspections; if use of ROV is not feasible, divers may be used for the subsea inspections. The structural integrity of the substructure, TP and ancillary structure (access ways, J-tubes, etc.) should be checked along with the level of corrosion and marine growth. If marine growth considered to be causing excessive loading on the foundation structure and/or restricting safe access, it should be removed as much as possible by high-pressure water cleaners using sea water with no additives for marine safety. In addition to that,

[97] Burbo Bank Extension Offshore Wind Farm, Environmental Statement, Dong Energy, 2013

bathymetry test should be carried out to inspect the condition of the seabed and scour protection, where applicable, around the base of the foundations. Bathymetry tests also enable inspectors to determine the presence of significant deterioration in the cable burial depths, which can occur as a result of sediment movements, seismic activity etc.

Corrective maintenance scheme typically includes repairs and replacements of electrical installations such as lighting, fog horns, navigation lights and transponders using crew vessels. While some corrective maintenance practices, such as anode or scour protection replacements, require the use of divers, some other major component replacement operations such as rotor blade replacement or boat landing replacements will require the use of a jack-up vessels.

We **recommend** BSEE to require a written annual inspection scheme for foundations of WTGs, OSP and Met-Mast from the OWF owners/operators. The requirements for the safety procedures and valid training certificates for all maintenance and inspections activities should be included in the annual maintenance and inspection plan.

ii. **WTG:** WTGs, including paint coating, are designed to maintain asset integrity during their design life such as 20 or 25 years. However, preventative and corrective maintenance procedures should be put in place to ensure that requisite maintenance practices are carried out to maintain the structural integrity of WTG components in accordance with the maintenance requirements of the designer/manufacturer of WTG.

Preventive maintenance normally includes tasks such as safety checks, replacement of consumables as well as a general inspection of WTG components. Preventative maintenance is most effective where risk based inspections are periodically carried out. It is typically carried out using crew vessels to access a WTG. While it is most common to transfer crew to WTG via boat landing using transfer vessels, it is also possible to transfer crew to WTG or OSP via heli-hoist using helicopters.

Corrective maintenance program typically includes minor repairs, restarts and component replacements such as bearings, generator, etc. Corrective maintenance is normally required when analyzed data obtained from condition monitoring systems suggest problems or monitoring alarms are triggered, some of which may result in WTG being remotely shutdown. WTG failure rates are expected to follow a bathtub curve, with increased failure rates during the first and last years of its design life. Corrective maintenance is typically carried out by using either crew boat or a specialized vessels such as jack-up vessel, self-stabilizing platform or accommodation vessel for larger OWFs; the type of vessel used for WTG maintenance mainly depends on the maintenance activity and weather conditions.

We **recommend** BSEE to require a written annual inspection scheme for WTGs from the OWF owners/operators. The requirements for the safety procedures and valid training certificates for all maintenance and inspections activities should be included in the annual maintenance and inspection plan.

iii. **OSP & Met-Mast:** Similar to WTGs, foundations and transition pieces, OSP and Met-Mast should also have preventative and corrective maintenance program. Preventive maintenance activities, which are typically carried out using crew vessels, and occasionally helicopters to access the OSP, should include tasks such as inspection of access facilities, deck, cranes, electrical components, safety equipment, consumables such as oil / grease and substructures (as explained in the foundation section above). Inspection on Met-Mast should include the structure, ladders and equipment such as such as anemometers, wind vanes, booms, aviation lights. Met-Mast inspections are typically carried out by using techniques that involve rope access, camera and remotely operated aerial vehicles.

Corrective maintenance program typically includes fault rectification, minor repairs involving component replacements as a result of usual wear and tear and / or breakdowns. The fault rectification is usually required either after a condition monitoring system gives a failure alarm or the findings of inspections and /or preventive maintenance activities detect a component failure. Corrective maintenance will be carried out by using crew vessels, helicopter or specialized operations vessel such as jack-up, depending on weather conditions and the details of the breakdown.

It is recommended for BSEE to require a written annual OSP and Met-Mast inspection scheme from OSP and Met-Mast owners/operators. The inspection scheme should include monthly inspections during regular operations and annual comprehensive inspections and maintenance during a shutdown once a year.

iv. **Subsea Cables:** The integrity of subsea cables is crucial for reliable power distribution from OWFs to shore, sometimes via OSP. Therefore it is of great importance that preventive maintenance program is put in place in a timely manner. Preventive maintenance activities, which are typically undertaken using special purpose vessels such as cable survey vessels, diving vessels, should include routine inspections to ensure the subsea cables remain buried to an adequate depth and that they are not exposed. The integrity of the subsea cables and cable protection system, including bending restrictors and bend stiffener, should also be inspected annually. Typical subsea cable inspections consist of acoustic surveys and ROV inspections for subsea cable condition monitoring including cable burial depth.

If the outcome of the inspections requires remedial measures to be taken to bury any exposed part of subsea cables by using methods such as additional jetting or placing of concrete mattresses or rock dumping on the subsea cable, then the additional maintenance activities will need to be carried out by using specialized vessels such cable laying vessels. These activities may require a new marine license or extension to the initial licenses granted; therefore such subsea cable maintenance works should not be carried out until a written maintenance methodology is agreed with the relevant regulatory bodies in advance.

We **recommend** BSEE to require a written annual subsea cable inspection scheme for from OSP and OWF owners/operators.

k. **Decommissioning**: A typical OWF is constructed with an expected design life of 20-25 years. At the end of this period an OWF may be re-powered by replacing WTGs and electrical components of OSP with newer, more efficient versions, if needed, depending on the integrity of the offshore substructures; this process is also subject to acquiring any relevant new consents. If extending the life-time of an OWF is not a viable option, then OWF will need to be decommissioned. At this stage, it is anticipated that all structures above the seabed will be completely removed. The dismantling and removal of WTG components (blades, nacelle, tower etc.) or OSP, Met-Mast components will largely require reversal of the installation process and therefore the activities will be subject to the same constraints. Using today's technology, dismantling of WTGs will require a jack-up vessel to ensure adequate control and to cope with the relatively high lifts and high crane hook loads. Even though decommissioning may not require the same level of precision and care as during installation, it still should be undertaken in the same controlled manner and in accordance with a risk management plan to ensure the same level of safety and pollution control measures.

The first phase of decommissioning involves obtaining requisite permits, putting necessary safety procedures in place, preparing risk assessment method statement for all offshore activities, selecting vessels and preparing OWF site.

i. **WTG Decommissioning**: The first phase of decommissioning involves OWF site preparation, which should include the following steps:
    - Implementation of de-energizing and isolating electrical control and power cables from national grid and SCADA system
    - Removal of all loose items from WTG
    - Installation/certification of lifting points
    - Hot bolting key bolts to aid unbolting process

Following the completion of the above activities, the WTG will be ready for dismantling; this process will involve the following activities in that specific order:

- Mobilization of a suitable jack-up vessel or barge
- Positioning of the jack-up vessel close to the turbine position
- Removal rotor blades
- Removal of nacelle
- Removal of tower sections
- Placement of WTG parts on a transport barge or on the vessel to be transported to the selected harbor
- Reuse, recycling or disposal of WTG parts in accordance with the applicable regulations

ii. **MP Foundation Decommissioning:** In this stage initially the transition piece needs to be cut just above the grouted connection and removed by crane. Following this process, the MP will need to be cut below the seabed level to a depth in order to ensure that the exposure of remaining foundation part will be unlikely. This level can be approximately one meter below seabed although the exact depth will vary depending on the sea-bed conditions and site characteristics at the time of decommissioning. The cutting works are likely to be done via a mechanical or water jet cutter.

Alternatively, if the soil conditions allow for it, the monopiles can be reverse-vibrated out of the ground instead out cutting the TP and MP sections. Dismantled TP and MP parts should be processed for reuse, recycle or disposal in accordance with applicable regulations.

iii. **WTG Jacket Foundation Decommissioning:** Following mobilization of a suitable vessel such as a jack-up vessel or heavy-lift vessel, ROVs or divers need to be deployed to inspect the foundation and reinstate lifting attachment, if needed. Using one of the methods outlined above, the legs of the jacket structure should be cut just above the piles and remove it by vessel crane. Before excavating outside and inside of piles to approximately 0.5 meter below anticipated level of cutting, any scour protection or debris around the base of the foundation should be removed. Once the foundations piles are cut at the required depth below the seabed, as per the MP foundation decommissioning process above, they can be removed by vessel crane.

Alternatively, similar to MP foundations, the jacket foundation can be reverse-vibrated out of the ground instead out cutting; for this process lifting attachment and vibrator should be installed to the jacket piles to start vibration in order to lift the jacket pile out of the ground. Dismantled parts should be processed for reuse, recycle or disposal in accordance with applicable regulations.

iv. **WTG Jacket Suction-Caisson Foundation Decommissioning:** The decommissioning process for the removal of jacket foundations with suction caissons starts with mobilization of a suitable vessel such as floating crane barge followed by deployment of ROVs or divers to inspect the substation foundation and reinstate lifting attachment, if required. Removal of this structure will involve pumping seawater inside the substation foundation shaft to create pressure, which will in return force the substation foundation out of the seabed. Following this process the jacket suction-caisson foundation gets lifted using vessel's crane onto a transport vessel for transportation to shore. Dismantled parts should be processed for reuse, recycle or disposal in accordance with applicable regulations.

v. **Scour Protection Decommissioning:** It is a known fact that scour protection create new marine habitat over the life of the OWF. Therefore it may be preferable to leave the scour protection in-situ to preserve the marine habitat after the consultation with the relevant authorities and stakeholders. If removal will be deemed necessary, for the rock armor layer scour protection, the removal process will need to start with removal of individual boulders using a grab vessel in order them to be transferred to a suitable barge or vessel for transport to designated onshore site for appropriate disposal or recycling. Where the scour protection filter layer is used, it will need to be dredged and transported to a licensed disposal area for disposal.

vi. **OSP Decommissioning:** The dismantling and removal of the offshore substation will include decommissioning of complete topside and substructure. This process follows a similar procedure to that described for the WTG and WTG foundation. A typical decommissioning of the topside will involve substation to be lifted onto a barge in one piece and transported to harbor for dismantling onshore.

Once the OSP is prepared for commissioning, all electrical control and power cables should be de-energized and isolated from national grid and SCADA system. Following this process, the terminations of export and array cables should be dismantled. After all cables are removed back to cable deck or seabed, all unsecured loose items and hazardous chemicals must be removed from the topside. Subsequently, welded stab-in connections between topside and foundation must be cut. Once this is complete, the topside with its electrical plant equipment can be lifted onto transportation vessel for transportation to shore. Once OSP topside is delivered to onshore location, the interconnections between electrical equipment can be dismantled and the oil from transformers can be extracted safely. Dismantled parts should be processed for reuse, recycle or disposal in accordance with applicable regulations.

The OSP foundations should be decommissioned using the same process outlined for the WTG foundations above.

vii. **Subsea Cable Decommissioning:** This part of OWF decommissioning plan will depend on the relevant authorities and stakeholders as the consultation process with them will be determine which sections of the subsea cables will need to be removed. If the regulators and stakeholder will be satisfied that the subsea cables will not likely to be exposed to present safety risk to marine habitat and marine navigation, they may agree for OWF owner to leave the subsea cables in situ. In this occasion the subsea cable ends will need to be cut as close to the foundation as possible either prior to foundation removal, or at the same time; the cable ends will need to be weighted down and buried using an ROV or divers to ensure they do not present safety risk. Where there is a cable or pipeline crossings, the subsea cables may need to remain in situ to avoid unnecessary risk to the integrity of the live subsea cables or pipelines.

If removal of subsea cables will be deemed necessary, they will need to be removed in the following order. First, the location of the subsea cables will need to be identified in which process seabed material may need to be removed to locate the subsea cables. This can be carried out using a water jetting tool similar to that used during cable installation. Once the location is identified, subsea cable can be removed using a grapnel to lift it from the seabed. If necessary, ROV may need to be used to cut or attach a lifting attachment to the cable so that subsea cable can be recovered to the vessel. The recovery vessel will either spool the recovered subsea cable into a carousel or chop it into lengths as it will bring it on-board before transporting to shore. Decommissioned subsea cables should be processed for reuse, recycle or disposal in accordance with applicable regulations.

viii. **Onshore Electrical Infrastructure Decommissioning:** If required, the process involved in onshore decommissioning will be subject to applicable regulations and requirements of the local planning authority.

Onshore Substation: The decommissioning process will start with a risk assessment process in which, potential hazards and pollutants to the environment will need to be identified and adequate risk mitigation plans will need to be put in place to ensure that onshore substation decommissioning is carried out with minimal risk of damage to environment. In the dismantling process, onshore substation will be disconnected from the high voltage transmission system, de-energized and all equipment will have to be earthed. Auxiliary supplies, where applicable, will need to remain at the site for decommissioning purposes. All electrical equipment/plant items will need to be dismantled and removed. Decommissioned parts should be processed for reuse, recycle or disposal in accordance with applicable regulations.

Transformers & Reactors: This is one of the critical parts of the decommissioning process. Prior to removal, the transformers will need to be drained of insulating oil which can then be re-processed for another use or disposed of in accordance with local hazardous chemical disposal requirements. Tap changers will also need be drained of oil, dismantled and disposed of; if the oil within the diverter is heavily contaminated it will need to be handled separately in accordance with specific hazardous chemical disposal requirements. Cable connections and bushings will need be removed and returned for re-conditioning or disposal. Any metallic components will need to be recycled and paper insulation will be disposed of in accordance with recycling requirements. Finally, any oil contamination around the transformer bund will need to be decontaminated.

Switchgear: Switchgear is filled with Sulphur Hexafluoride, which will need to be disposed of in accordance with specific hazardous chemical disposal requirements. Before dismantling the switchgear all external connections will have to be removed and vacuum will need to be drawn on the sealed gas zones to removing the Sulphur Hexafluoride, instead the equipment will need to be refilled with an inert gas. Wherever possible, sealed gas volumes will need to be removed without opening in order to get hazardous chemical such as fluorides, sulphides etc. to be decontaminated by an authorized facility. However, if it will be necessary to open gas zones in-situ to dismantle substation, it will be necessary to decontaminate hazardous chemicals on site before transporting the dismantled equipment. Once decontamination will be carried out the equipment can be re-used recycled or disposed of in accordance with applicable regulations.

Filters & Statcoms: Unopened oil filled capacitor cans will need to be removed and transported to be properly disposed of. Statcom coolant systems will also need to be drained and coolant fluid will need to be removed from site for disposal. The metallic elements of equipment such as air cored reactors, resistors etc. will be most likely recycled. Finally, power electronics equipment will need to be disposed of in accordance with applicable regulations.

Earthing Systems: Copper earth tape will need to be removed from the equipment to be recycled. Copper earth electrodes and substation earthing matt will also need to be removed from the site to be recycled.

Busbars, Equipment Supports and Intra-Site Cabling: Copper and aluminum busbars and other metallic equipment will need to be removed to be recycled. Concrete support structures will need to be demolished like other site structures. Power, auxiliary and communication cables within the site boundary will need to be removed and recycled or disposed of in accordance with applicable waste management regulations.

Site drainage and Buildings: Oil containment systems will have to be removed and any oil residue will have to be cleaned to be disposed of. Depending on the planning permission and the requirement of the authorities, the site buildings may be demolished and demolition waste may need to be removed for recycling or disposal.

Onshore Export Cable: Similar to the subsea cables, prior to the removal of the onshore cables relevant authorities and stakeholders will need to be consulted with in order to determine which sections of the onshore cables will need to be removed. Usually it is preferred to leave the decommissioned onshore cables in-situ due to the disruption caused by their removal. The onshore cable ends will need to be cut and any over ground installations such as fiber optic and link boxes will need to be removed. Horizontal directional drill sections for road/river crossings etc. may need to remain buried due to the complication and potential disruption that their removal poses to cause unless it is absolutely essential for the re-purposing of a site.[98]

We **recommend** BSEE to require a preliminary decommissioning plan from OWF owners. The decommissioning plan should be reviewed by BSEE with relevant authorities for approval. Decommissioning operations should be supervised by a BSEE approved party, and if necessary BSEE should initiate inspections to ensure that disassembly of all OWF components are carried out in accordance with approved code of practices and that dismantled pieces are recycled or disposed in accordance with applicable regulations.

3. Examine Major Safety and Environmental Concerns (Task 2)

Since the advancements in wind technology enabled the wind power generation move from onshore to offshore, the importance of design and operational safety and environmental compliance has been accentuated by regulators, developers and other stakeholders at large. This section examines the major safety and environmental concerns for the operation of OWFs in order to identify the critical structures and components, which should be subject to inspections. In this study we do not only focus on inspection requirements for the offshore structures and components but also review issues associated with ONWF where the concerns are also applicable to OWFs.

It is stated in the Special Report 310 – Workers Health & Safety[99] that the overall risk to the health and safety of workers and to the environment associated with an offshore oil and gas platform is greater than that associated with an offshore wind turbine. As mentioned in the introduction section of this study, this statement is not completely accurate as the occupational health and safety risks are considerably high during the construction phase of OWF and ONWFs. Those risks mainly stem from activities which include lifting/loading/transporting/unloading/installing/wind turbine components, foundations etc., carrying out other installation activities such as connection cables onshore and offshore, which may involve diving.

Besides, repetitive installation practices such as installing each blade at a time or connection array cable at a time have shown in Europe that more repetitive activities increase risks as installation teams become more lenient and pay less attention to requisite installation processes. For example, as each blade or array cable is installed by a crew, after few successful installation practices their perception of risks changes as they succeed initial installation activities without fault or incident, which impairs judgment of safety risks resulting in them underestimating the risks inherent in those installation processes. So, it is important to acknowledge and not to underestimate the human factor, which has

[98] Burbo Bank Extension Offshore Wind Farm, Environmental Statement, Dong Energy, 2013 http://infrastructure.planningportal.gov.uk/wp-content/ipc/uploads/projects/EN010026/1.%20Pre-Submission/EIA/Scoping/Scoping%20Request/100708_EN010026_EIA%20Scoping%20Report.pdf

[99] Special Report 310 - Worker Health and Safety on Offshore Wind Farms , page 142, Transportation Research Board of National Academies, Washington, D.C., 2013

caused incidents, accidents and fatalities both in repetitive wind farm component installation processes of OWF and ONWF construction projects.

MMS Technology Assessment & Research (TA&R) Project 627-Inspection Methodologies for Offshore Wind Turbine Facilities Report[100] points out that for fixed and floating oil and gas platforms for drilling and production both prescriptive and Risk-Based Inspection (RBI) programs have been implemented; and recommends this experience to be taken into account for developing inspection guidelines for offshore wind turbine structures and systems. This approach is welcomed and furthermore it is suggested for safety inspections to follow a similar approach.

In the Special Report 310 – Workers Health & Safety, a list of hazards is provided[101] which are common both in wind farm and oil and gas asset installations and operations. Those include the following: assembly and fit-up (installation only), chemical exposure, confined space entry, crane and lifting, demolition (decommissioning only), diving, dropped objects, electrocution and arc flash, emergency evacuation, electric and magnetic field exposure (operations only, once power is being generated), falls from height, fire, human factors health issues (climbing, awkward postures), human factors safety issues (pinch points, rotating equipment), noise exposure, personnel transfers (falls into the water); access by boat; access by helicopter, slips and trips, vibration, weather exposure.

The same report makes comparison between those hazards in terms of their significance. For example the report states that the risk of electrocution is higher when working in wind turbines in comparison to work carried on oil and gas platforms, which is an accurate statement, it also states that the risk of falling into water is similar both for offshore wind turbine sand oil and gas platform, which is not entirely accurate. It is because the nature of WTG maintenance activities such as accessing to each offshore wind turbine via boat landing or carrying out external blade inspections via rope access involves greater risk of falling into water. Likewise the diving risk is greater in OWF installation and maintenance practices in comparison to the diving practices for oil and gas assets. It should be remembered that today an average size OWF in Europe has at least 30-40 WTGs and sheer number repetitive installation and maintenance practices involve much greater safety risks than portrayed in the Special Report 310 – Workers Health & Safety report.

From the accident statistics (Table 24) recorded in offshore wind farm construction projects in Europe, it is seen that the safety risks are much greater in construction phase of OWFs. For example, the UK health and Safety Executive Offshore Injury, Ill Health and Incident Statistics 2011/2012 show a number of accidents and fatalities in wind farm projects (there were OWF projects) in the UK[102]. The OWF incidents

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[100] MMS TA&R Project 627 – Inspection Methodologies for Offshore Wind Turbine Facilities Report, page 3, Energo Engineering Inc, Houston, January 2009

[101] Special Report 310 - Worker Health and Safety on Offshore Wind Farms, Transportation Research Board of National Academies, page 37, http://www.nap.edu/booksearch.php?booksearch=1&term=Special+Report+310+-+Worker+Health+and+Safety+on+Offshore+Wind+Farms&record_id=18327

[102] Offshore Injury, Ill Health and Incident Statistics 2011/2012, Health and Safety Executive, UK, 2012

http://www.hse.gov.uk/offshore/statistics/hsr1112.pdf figures, shown in braces, are included in the total numbers. According to the UK Health and Safety Executive, in addition to three fatal accidents in 2009/10, a total of 53 major or dangerous incidents occurred in 2007/08 and 2009/10 in the OWF and ONWF installation and operation phases. The UK Health and Safety Executive also acknowledged that it was “extremely difficult” to assemble a “complete picture of reported incidents at wind farms” because accidents are not recorded by industry type. RenewableUK, which is the UK's leading not for profit renewable energy trade association, recorded 1,500 incidents over the past five years, many of which were very minor; of those, about 300 incidents led to minor injuries.

Narrative	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12
Fatalities	3	0	3	0	2	2	0	0	0	0	2
Major Injuries	47	64	48	48	50	39	44	30	*50(1)	*42(3)	36
Total Fatalities & Major Injuries	50	64	51	48	52	41	44	30	50(1)*	*42(3)	38
Over-3-Day Injuries	187	120	103	111	125	164	148	140	*110(1)	*106(4)	*95(8)
Total Injuries	237	184	154	159	177	205	192	170	*160(2)	*148(7)	*133(8)
Dangerous Occurrence	661	635	530	558	491	485	509	477	434	430	409

Table 24 – Summary of Injuries & Dangerous Occurrences in the UK 2001-2012

In Europe 9 major utility firms namely, Centrica Energy, Dong Energy, EON, RWE, Scottish Power, Scottish and Southern Energy, Statkraft, Statoil and Vattenfall, set up a group called G9 Offshore Wind Health and Safety Association (also called G9). According to G9, the primary aim of this group is to deliver world class health and safety performance in the offshore wind industry. To achieve this, senior executives of the G9 member companies have committed resources from their companies, and have also met under the auspices of the G9 Board, to actively lead the industry in finding solutions to the safety challenges faced by offshore wind projects throughout their life cycle, from design and development through construction and in operation.

Through the sharing and analysis of HSE incidents provided by G9 member companies, an evidence-based understanding has been developed of the risks encountered during the construction and operational phases of a wind farm project. This information is being used by the G9 to identify the risks in the offshore wind industry, allowing the group’s work to be focused in areas of high risk exposure[103].

G9 2013 Annual Incident Data Report presents a summary of incidents recorded in OWF installation and operation phases in 2013 in Europe. Table 25 below shows the key health and safety facts and figures recorded in 2013. Marine operations, which is listed in the Table 25, comprises the following work processes maritime operations, transfer by vessel, vessel operations, vessel mobilization.

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[103] 2013 Annual Incident Data Report, G9 Offshore Wind Health and Safety Association,

http://www.g9offshorewind.com/__data/assets/pdf_file/0011/106121/G9report-finalversion-WEB.pdf

Key Facts		Work Process	
616	reported incidents	165	**lifting operations** incidents
0	**fatalities**	45	incidents occurred when **working at height**
66	total **lost work days**	131	incidents during **marine operations**
4	injuries to employees and contractors reported under **RIDDOR**	**Incident area**	
373	incidents occurred on **operational** sites	281	incidents occurred on **vessels**
243	incidents occurred on **project** sites	178	incidents occurred in the **turbine** region
		124	incidents occurred **onshore**

Table 25 – Key Health & Safety Facts and Figures[104]

3.1.Common Reportable Incidents and Accidents

This section addresses the common reportable incidents, accidents, etc. Section 1.23 of this study addresses the type of reportable accidents data compiled by CWIF. According to the data presented by CWIF the most reportable accidents were caused by failure in WTG, rotor blade, WTG fire, electrocution, structural failure, ice throw and transportation of WTG components.

G9 2013 Annual Incident Data Report also provides very useful summary of incidents per area of operations for all OWF sites in Europe in 2013 as shown in Table 26. Those health and safety statistics show that the majority of the near hits (199 near hits) were recorded for the vessel operations followed by WTG tower installation (34 near hits) and operations at harbor, quay and pontoons (24 near hits). It is not surprising that majority of lost works days recorded during the offshore foundation installation (19 accidents) followed by accidents involving access ladders (11 accidents). As for the accidents requiring medical treatment were mostly recorded in the activities involving public road/area (7 incidents), offshore foundation installation (6 incidents) and access ladders (3 incidents).

[104] 2013 Annual Incident Data Report, G9 Offshore Wind Health and Safety Association, page 4

Incident Area	RWD*	MTI**	First Aid	LWD***	Hazards	Near Hits	Total
Accommodation Platform			1				1
Boatlanding		1		1			2
Foundation Internal		1	6	3		34	44
Turbine Assembly Area		1	5	5	8	24	43
Warehouse		1	2	7	2	11	23
Excavations and Civil Works		1			1	1	3
Hub and Blades		1			2	4	7
Workshop 1 1 2		2	4	2	6	22	36
Administration	2	2	1	2	9	16	32
Yaw gear space		2	1	2		11	16
Access Ladders	2	3	1	11	3	26	46
Foundation External	6	6	26	19	41	101	199
Public Road/Area		7	2	4	5	22	40
Helicopter Hoisting and Landing Area			2	1	4	5	12
Kitchen and Canteen	2		2	1	4	15	24
Storage			1	1	11	9	22
Access Roads				1		1	2
Car Park				1		2	3
Company Vehicle			2	1		3	6
Staircase			2	1		9	12
Substation HV areas (>1 000 V)				2	1	10	13
Turbine/Substation Outside				2		4	6
Met Mast					1		1
Substation Work and Cable Areas					1	1	2
Office					1	1	2
Transition Piece Area					4	3	7
Vessels – small (< 24 m)						1	1
Nacelle						1	1
Harbour, Quay and Pontoons			1			1	2
Turbine Tower						2	2
Vessels – large (>24 m)			1			1	2
Vessels						4	4
Total	12	28	60	67	104	345	616

(*) Restricted Work Day (**) Medical Treatment Injuries (***) Lost Work Day

Table 26 – Incident Area Summary for all OWF sites in Europe (2013)[105]

There are a number of incidents in the wind energy industry, which demonstrates that the most common reportable incidents and accidents are caused during onshore/offshore transportation, installation and maintenance phases of wind farm projects. However, presently there is not a single organization which monitors, collects and analysis the safety performance in the wind energy industry, which makes it rather difficult to adequately quantify the most common reportable incidents and accidents. In order to tackle this issue, publicly available safety reports of several organizations has been collected to collate information about the common reportable incidents and accidents in the wind energy industry. The information provided in the table below provides a representation of common

[105] 2013 Annual Incident Data Report, G9 Offshore Wind Health and Safety Association, page 15

reportable incidents and accidents in the wind energy industry in recent years. It should be noted that, the most of the reportable incidents and accidents are not publicly available and therefore the table showing the reported incidents and accidents does not cover accidents such fall from heights, slip, trips, falls, strain injury etc. caused while working in offshore and onshore wind farm sites.

Date	Country	Phase	Type	Incident / Accident	OWF / ONWF			
12/1/05	USA	O&M	Accident	Mech & Struct Failure	ONWF	Onshore Site	WTG in Sunderland caught fire in nacelle and spread to the rotor blades before finally burning out. Both lanes of the nearby A19 trunk road had to be closed to traffic because of the danger caused by the wind turbine fire. As the WTG tower was 200 feet high, it was not accessible to fire crews. Eventually, all 3 of the 75 foot long rotors blades, or what was left of them, dropped off. No one was hurt in this incident.	http://www.windfarmaction.com/wind-turbine-explodes.html
2/1/08	Denmark	O&M	Accident	Mech & Struct Failure	ONWF	Onshore Site	WTG buckled and collapsed in Denmark. No one was hurt in this incident. This investigation was conducted following a request from the Energy Agency's Secretariat for the Danish Wind Turbine Certification Scheme, together with experts from Risø DTU.	http://www.windaction.org/posts/20929-final-report-on-investigation-of-a-catastrophic-turbine-failures-february-22-and-23-2008

Date	Country	Phase	Type	Incident / Accident	OWF / ONWF	Location	Info	Source
2/1/08	USA	O&M	Fatality	Wrong WTG Start-up Procedure	ONWF	Onshore Site	WTG collapsed killed one worker and injured another in an onshore wind farm in Oregon. The investigation found no structural problems with the tower. Oregon OSHA stated that the accident was the result of a system that allowed the operator to restart the turbine after service while the blades were locked in a hazardous position. Three wind technicians were performing maintenance on a wind turbine tower. After applying a service brake to stop the blades from moving, one of the workers entered the hub of the turbine. He then positioned all three blades to the maximum wind resistance position and closed all three energy isolation devices on the blades. The devices are designed to control the mechanism that directs the blade pitch so that workers don't get injured while they are working in the hub. Before leaving the confined space, the worker did not return the energy isolation devices to the operational position. As a result, when he released the service brake, wind force on the out-of-position blades caused an "over speed" condition, causing one of the blades to strike the tower and the tower to collapse, according to the Oregon OSHA investigation.	http://www.taproot.com/archives/2079
1/1/09	UK	O&M	Accident	Mech & Struct Failure	ONWF	Onshore Site	Two rotor blades of a WTG were damaged after making contact with the tower while in operation resulting in structural failure. No one was hurt in this incident.	http://www.saveoursalcey.com/?q=turbine_accidents
5/1/10	UK	C	Fatality	Crane Accident	OWF	Offshore Site	45 ton blade root was being lifted in an H-type lifting frame by a jack-up vessel, when the frame gave way and dropped the load crushing a banksman who had, along with a colleague, been trying to land the load into its stowage rack on board the vessel. Second worker was seriously injured.	http://www.vertikal.net/en/news/story/10145/

Date	Country	Phase	Type	Incident / Accident	OWF / ONWF	Location	Info	Source
2/1/11	USA	C	Fatality	Bulldozer Accident	ONW	Onshore Site	A man working on building a wind farm nearby Livermore was killed after a bulldozer rolled over on top of him. The Alameda County Fire Department of California received reports that a bulldozer driving on N. Vasco Road rolled down the embankment, possibly also killing the driver.	http://www.wind-works.org/cms/index.php?id=43&tx_ttnews%5Btt_news%5D=414&cHash=5a7a0eb3236dd3283a3b6d8cf4cc508b
3/1/11	USA	O&M	Incident	Bolt Failure	ONWF	Onshore Site	Bolt failures caused a WTG rotor and blades to fall from a tower in North Dakota. No one was hurt in this incident.	http://www.businessweek.com/ap/financialnews/D9M5VDA00.htm
8/1/11	USA	T	Incident	TranspAccident	ONWF	Public Road	Two semi-tractor trailers carrying rotor blades crashed on the public road. No one was injured.	http://www.thonline.com/news/breaking/article_fe7deb6c-c8d5-11e0-9ab6-001a4bcf6878.html
12/1/11	UK	O&M	Accident	Mech & Struct Failure	ONWF	Onshore Site	One of the WGS in onshore wind farm exploded in high winds. No one was hurt in this incident.	http://www.newscientist.com/blogs/onepercent/2011/12/why-did-a-wind-turbine-self-co.html
1/1/12	Germany	C	Fatality	Ladder Failure	OWF	Offshore Site	The body of an installer working on the foundations at Bard Offshore 1 was recovered after he had been dragged under water during assembly work. The offshore installation worker was helping to assemble the tri-pile foundation when the ladder to which the he was hooked up became detached. As the ladder fell into the depths, it took the installer with it. A second employee was able to escape unharmed. A search team recovered his body two days later. The platform he was working on was attached to the tower with a metal band encircling the tower. The ring was not otherwise attached. The ring slipped into the sea dragging the worker with it.	http://www.renewablesinternational.net/tragedy-at-offshore-wind-farm/150/505/33028/

Date	Country	Phase	Type	Incident / Accident	OWF / ONWF	Location	Info	Source
1/1/12	UK	O&M	Accident	Mech & Struct Failure	ONWF	Onshore Site	A WTG rotor blade broke off at an onshore wind farm near Glasgow. No one was hurt in this incident.	http://www.habitat21.co.uk/wind47.html
2/1/12	Spain	O&M	Fatality	Road Accident	ONWF	Onshore Site	While driving to an onshore wind site the vehicle containing two service technicians went off the track, overturned. One of the technicians died in the accident, the other one was injured.	http://www.abc.es/agencias/noticia.asp?noticia=1095470
6/1/12	China	C	Fatality	Fire	ONWF	Onshore Site	Two maintenance personnel were in the nacelle eliminating frequency converter faults during the regular maintenance work when the turbines caught fire. The firefighting apparatus could not reach the hub height of 80-metres, there fire fighters could not put off the fire. WTG burnt for about 12 hours and extinguished by itself. The wind turbine nacelle was burnt away, and the three blades were damaged to varying degrees. The fire fighters found one body at the second platform of the wind tower, who had died as a result of head injuries according to the post-mortem. The other engineer's body was not found. The cause of the fire remained unknown.	http://www.windpowermonthly.com/windalert/news/login/1118311/
9/1/12	China	O&M	Fatality	Structural Failure	ONWF	Onshore Site	Collapse of a WTG killed one worker and injured three others in an onshore wind farm in China last week.	http://www.rechargenews.com/energy/wind/article322729.ece
12/1/12	Germany	C	Fatality	Crane Accident	OWF	Onshore Site	A construction worker died after a rotor blade dropped onto his crane cabin at the site in Mannhagen. Contractors were installing turbines at the site near Germany's Baltic Sea coast.	http://www.rechargenews.com/energy/wind/article328891.ece

Date	Country	Phase	Type	Incident / Accident	OWF / ONWF	Location	Info	Source
1/1/13	UK	C	Fatality	Fall from Man-Basket during Transfer	OWF	Vessel	A crew member suffered a fatal fall from a Billy Pugh X-800 series personnel basket during a transfer between an incomplete jacket platform (OSP) and heavy lift barge. The basket started swinging and the person fell and landed on a walkway of the jacket platform, suffering serious head injuries. He was evacuated to hospital and subsequently died of his injuries.	http://www.imca-int.com/safety-environment-and-legislation/safety-flashes/2013.aspx
1/1/13	UK	C	Loss Time Injury	Falling into Tank	OWF	Vessel	During preparation for tank cleaning onboard a vessel, one of the crew fell from the main deck down in starboard methanol tank. The fall height was 4.30 meter. The AB was securing the area with blocking (barrier) tape and while moving backwards, he stepped into the tank. The injured person (IP) fractured his femur.	http://www.imca-int.com/safety-environment-and-legislation/safety-flashes/2013.aspx

Date	Country	Phase	Type	Incident / Accident	OWF / ONWF	Location	Info	Source
2/1/13	UK	C	Loss Time Injury	Serious Diving Accident	OWF	Vessel	During diving operations when dive support vessel (DSP) suffered a dynamic positioning (DP) control system failure and consequent uncontrolled vessel movement. Diver 1 and Diver 2 were located within a subsea drilling template, in 90 meter water depth, carrying out valve operations for barrier testing when a number of DP alarms sounded related to K-Pos Redundant Communication BUS. The amber alarm was activated, which was followed by red alarm shortly afterwards and the instruction was immediately given by the dive supervisor for the divers to make their way back to the dive bell staging. While the divers were attempting to relocate back to the bell staging the vessel lost DP control and started to drift-off at which point Diver 2's umbilical snagged on a transporter bucket located on the west face of the drilling template. The vessel continued to drift and Diver 2’s umbilical severed resulting in the diver losing surface supplied gas, hot water and communications. Diver 2 immediately went onto bail out and made his way back onto the template structure roof. Diver 1 successfully located back to the bell staging.	http://www.imca-int.com/safety-environment-and-legislation/safety-flashes/2013.aspx

Date	Country	Phase	Type	Incident / Accident	OWF / ONWF	Location	Info	Source
4/1/13	UK	C	Near Miss	Dropped Handrail / Gate near MP	OWF	Vessel	A member has reported an incident in which a handrail gate was dislodged from its retaining points and fell 4.5m to the deck. The incident occurred after crew members moved a lifting mandrel to secure it against a mezzanine deck. The lifting mandrel started swinging fore and aft, and a crew member went to the forward winch and attempted to draw on the lifting mandrel tension wire and secure it. During this tensioning of the wire, the mandrel/wire rose under the lower bar of the mezzanine deck center handrail gate, dislodging it from its retaining points. The handrail gate, which weighed 8kg and was 100cm across, fell 4.5m to the deck, landed and bounced once. There were no injuries, but it was calculated that such an object falling from that height might have caused a fatality had it hit someone. Hence the event was categorized as a high potential near miss.	http://www.imca-int.com/media/96568/imcasf04-13.pdfhttp://www.imca-int.com/media/96568/imcasf04-13.pdfhttp://www.imca-int.com/media/96568/imcasf04-13.pdf
4/1/13	UK	C	Near Miss	Turnbuckle Falling to Deck	OWF	Vessel	During a period of high winds offshore (+ 40 knots) a turnbuckle (photo 1 below) fastened to the side of an elevated structure (photo 2 below) became sufficiently loose to detach itself and fall approximately 45 meters to deck. No personnel were nearby the area of impact when this incident occurred. The incident was caused, because no locking nuts were fitted to the turnbuckle during its installation on the structure.	RenewableUK
4/1/13	UK	O&M	Injury	Fixed Rail Fall Arrest Accident	ONWF	Onshore Site	Fall Arrest slider sliding down the fixed rail uncontrolled when released by the technician causing an injury in a WTG.	RenewableUK

Date	Country	Phase	Type	Incident / Accident	OWF / ONWF	Location	Info	Source
9/1/13	India	O&M	Fatality	Fall	ONWF	Onshore Site	Report of 2 fatalities involved in the replacement of a wind turbine generator on a 50m lattice tower. Five people working for a local contractor were replacing a wind turbine generator on a 50m lattice tower. They were using a pulley wire winch with one tractor to lift the new generator instead of using a heavy crane. The fixture of the wire winch was anchored to the nacelle bedplate. During the lifting operation, the fixture broke and the generator fell to the ground. The nacelle was badly damaged and two of the workers that were working in the nacelle fell to the ground and died instantly.	RenewableUK
9/1/13	Italy	O&M	Fatality	Trip	ONWF	Onshore Site	O&M worker who was moving away from an unstable anemometer, tripped on the tension cable, hit his head against a rock and died instantly.	RenewableUK
10/1/13	UK	C	Loss Time Injury	Foot Injury	OWF	Vessel	Crewman seriously injured his foot during cable laying for an offshore wind farm. During a mooring operation one of the crewmen attached the rope. He signaled to the Master in the wheelhouse that he was clear to back away from the tower. He then stepped out of sight of the Master. The Master applied full reverse power briefly, to get away safely from the tower, then put the engines into neutral. The crewman was then seen being dragged by the foot, which was attached to the mooring line, across the foredeck. The rope pulled him into a gap between the hand rail sections causing a serious injury to his foot. The operation was stopped for medical assistance. Medics from the DP2 vessel attended and provided initial treatment before the crewman was conveyed by helicopter to hospital. As a result of the injury the crewman suffered a partial amputation to his foot which included the loss of his toes.	http://www.imca-int.com/media/128174/imcasf16-13.pdf

Date	Country	Phase	Type	Incident / Accident	OWF / ONWF	Location	Info	Source
10/1/13	UK	C	Near Miss	Turnbuckle Falling to Deck	OWF	Vessel	During the laydown of a Crane master compensator, the lower shackle and link pate moved without control just before a rigger was about to re-sling the shackle and link plate to reposition it. No personnel were in the barrier zone and no personnel were injured as a result of this incident.	RenewableUK
10/1/13	UK	O&M	Incident	OWF service Vessel Collision	OWF	Vessel	A wind farm service vessel lost control of its jet drives. The incident occurred when a wind farm service vessel was underway returning to port from the wind farm. Control of the port jet was lost and the vessel veered heavily to port. The port jet was shut down and the vessel returned to base on one engine escorted by another wind farm service vessel. An M6 size bolt, securing the steering feedback transducer plate to the end of the steering ram, had vibrated loose and fallen off into the bilge; this resulted in a loss of steering control of the unit.	http://www.imca-int.com/media/121444/imcasf12-13.pdf

Date	Country	Phase	Type	Incident / Accident	OWF / ONWF	Location	Info	Source
10/1/13	UK	O&M	Incident	OWF service Vessel Collision	OWF	Vessel	A member has reported an incident in which a wind farm service vessel collided with a turbine foundation, after failure of the vessel jet drive. The incident occurred after the vessel had disembarked passengers at the sub-station and had reversed away to drift, whilst standing by for the next assignment. The jets were disengaged and engines left running, as was common practice. Under the influence of currents, the vessel drifted towards another turbine foundation and when approximately 30m away, the vessel coxswain/skipper attempted to engage the jets. At this moment it was found that neither jet would engage. Several minutes were spent fault finding to no avail, after which the vessel coxswain/skipper assisted the deckhand with fenders. The vessel collided with the foundation, causing a buckled frame and bent plate in the port quarter bulwark, but no damage to the foundation.	http://www.imca-int.com/media/121444/imcasf12-13.pdf
11/1/13	UK	C	Near Miss	Shackle Configuration	OWF	Vessel	Third party lifting inspector found that a 1 ton lifting shackle had lost a pin and the missing pin had been replaced with a standard bolt and nut which was not certified for lifting operations. Additionally, the shackle was found to be pinched due to excessive pressure being applied when tightening the nut due to the bolt having thread along its entire length.	http://www.imca-int.com/safety-environment-and-legislation/safety-flashes/2013.aspx
11/1/13	Netherlands	O&M	Fatality	Fire	ONWF	Onshore Site	Fire broke out (probably in the nacelle) of an 80m high wind turbine while four technicians were working. The fire blocked the way down of two technicians and they could not escape. While two technicians managed to get out, the other two technician died in the fire.	http://renews.biz/52979/two-dead-after-dutch-turbine-fire/

Date	Country	Phase	Type	Incident / Accident	OWF / ONWF	Location	Info	Source
3/1/14	UK	O&M	Injury	Fire	OWF	Vessel	A 14m wind farm support catamaran caught fire. The three crew members on the vessel were unable to extinguish the fire, which spread rapidly throughout the vessel, forcing them to abandon to a life raft. One person was slightly injured. It was discovered that there had been no control of work, no isolations or barriers, no risk assessment or tool box talk in place.	http://www.imca-int.com/safety-environment-and-legislation/safety-flashes/2014.aspx
4/1/14	USA	O&M	Fatality	Plane Crash	ONWF	Onshore Site	Four men were killed in after their plane collided with a wind turbine in South Dakota during foggy weather.	http://london.ctvnews.ca/ontario-pilots-worried-about-wind-turbines-after-u-s-crash-1.1809128http://london.ctvnews.ca/ontario-pilots-worried-about-wind-turbines-after-u-s-crash-1.1809128
7/1/14	Spain	O&M	Near Miss	Fire	ONWF	Onshore Site	Fire started in the ground controller electrical cabinet located at the base of a onshore WTG in a demonstration wind farm, which resulted in a person having to evacuate the nacelle using the emergency descender device. The machine was stopped but powered up.	A WTG Manufacturer

Date	Country	Phase	Type	Incident / Accident	OWF / ONWF	Location	Info	Source
8/1/14	UK	O&M	Environmental Accident	Oil Leak into the Sea	OWF	Offshore Site	The 40 meter-long ship collided with one of the turbines at an Offshore Wind farm in the UK territorial waters. Following the accident, the ship was refused entry to docks because its engine was leaking diesel oil as a result of the collision. The ship was able to move under its own steam and the crew was told to await further instruction in waters away from environmentally-sensitive areas. The Maritime and Coastguard Agency then arranged for a small plane to fly over the ship, to assess the extent of the leak, and reported a surface sheen up to 10 meters wide and around 0.7 nautical miles in length trailing the vessel. No one was hurt and WTG was not damaged.	http://www.nwemail.co.uk/news/oil-leaks-into-sea-after-ship-hits-wind-turbine-off-barrow-coast-1.1155604#
9/1/14	UK	O&M	Incident	Fire	OWF	Vessel	Report of an incident on a workboat used in the offshore wind farm industry, in which there was a serious failure of an alternator bearing, leading to a small engine room fire. The vessel crew noticed a sound change from the engines and a reduction in revs (dropped by about 100 rpm) followed immediately by the fire alarm. The crew shut the fire flaps, and the fuel and ventilation shut off using the emergency stops. The engine room was checked, and smoke and small flames or glowing were observed from the alternator. The fire was extinguished, the safety of crew, passengers and vessel was confirmed, and the vessel returned to port on one engine.	http://www.imca-int.com/safety-environment-and-legislation/safety-flashes/2014.aspx

Date	Country	Phase	Type	Incident / Accident	OWF / ONWF	Location	Info	Source
9/1/14	UK	O&M	Near Miss	Fire	OWF	Vessel	An incident has been bought to IMCA's attention in which there was a small fire in the starboard engine space on a crew transfer vessel used in the offshore wind farm sector. The incident occurred when on passage to an offshore wind farm. Shortly after leaving port, the fire alarm was activated in the starboard engine. Dark smoke was observed coming from the drain hole in the after inspection hatch of the starboard engine. On the CCTV into the engine space there was no indication of flames. The starboard engine was shut down and full fire procedures were carried out. The CO2 system was also used, however on inspection after the incident it was found that the system had not deployed. Shore authorities were alerted and the vessel returned to port on one engine. All staff were safely landed ashore and the fire confirmed to be extinguished	http://www.imca-int.com/safety-environment-and-legislation/safety-flashes/2014.aspx
9/1/14	UK	O&M	Near Miss	Dropped Object	OWF	WTG	A member reported an incident in which tools were dropped from height. The incident occurred during pick up of engineers from a wind turbine tower. A wind farm workboat was 'pushed up' against a turbine to collect two technicians, who were descending the tower. As they did so, a ratchet and two sockets fell from the work pouch of one of the technicians, and landed on the on the bow/deck of the vessel. The ratchet – weighing 0.5kg – and sockets fell approximately 15m and landed centimeters from the crewman on board the vessel. There were no injuries and the technician then continued his descent down the ladder to board the vessel. All persons were wearing appropriate personal protective equipment.	http://www.imca-int.com/safety-environment-and-legislation/safety-flashes/2014.aspx

Date	Country	Phase	Type	Incident / Accident	OWF / ONWF	Location	Info	Source
12/12/14	UK	O&M	Incident	Fire	OWF	Vessel	Incident related to a small fire in a below-decks space on an offshore wind turbine crew transfer vessel (CTV). The incident occurred whilst the CTV was near a wind turbine tower, with the passengers working as engineers on the turbine tower. Although there were no injuries, both the vessel master and the crewman inhaled some smoke and powder from the extinguishers they reported feeling "chesty" and had headaches, but no further medical advice was sought. There was some damage to fittings and equipment on the crew transfer vessel.	http://www.imca-int.com/safety-environment-and-legislation/safety-flashes/2014.aspx
1/1/15	UK	O&M	Accident	Mech & Struct Failure	ONWF	Onshore Site	A 328-foot tall WTG buckled and collapsed on a mountainside in Northern Ireland. No one was hurt in this incident. According to unconfirmed reports, the blades of the turbine had spun out of control - despite only light wind speeds - before the structure came crashing to the ground.	http://www.telegraph.co.uk/news/earth/energy/windpower/11324119/Wind-turbine-collapses-in-Northern-Ireland.html
2/1/15	UK	O&M	Accident	Man Overboard	OWF	Vessel	A company has reported a man overboard incident in which the person who fell overboard was recovered onboard uninjured within several minutes. The incident occurred when one wind turbine crew transfer vessel went to assist another such vessel which had reported propulsion problems. His lifejacket inflated immediately and as he swam towards the other vessel, the master onboard carried out a man overboard recovery procedure and the casualty was recovered onboard uninjured within several minutes.	http://www.imca-int.com/safety-environment-and-legislation/safety-flashes/2014.aspx

Table 27 - Common Reportable Incidents and Accidents

A sample of incidents and accidents shown in Table 27 demonstrates that they could have been avoided by complying with relevant safety procedures, carrying out timely inspections and implementing requisite preventive maintenance practices, where applicable.

It is recommended for BSEE to audit OWF and ONWF owners/operators to ensure the following:

a. All WTG components must only be transported after completing route surveillance by taking into account the road widths, bridge heights, traffic conditions etc.

b. All truck drivers carrying WTG components to and from ONWF sites must follow relevant company driving policies and use escort vehicles, when loaded, to ensure safe distance between WTG trucks and the public traffic.

c. All technicians driving themselves to and from ONWF sites must follow relevant company driving policies and using escort vehicles to ensure safe distance between WTG trucks and the public traffic.

d. All crew members involved in the transportation of WTG components, foundations, OSP topside, Met-Mast and the transfer of maintenance crew offshore must comply with maritime safety regulations and offshore wind farm safety guidelines.

e. All workers involved in offshore wind farm construction and operation activities must be properly instructed and supervised in the safe practices, procedures, process and safe operation of machinery, tools, equipment which they are authorized to use or apply.

f. The technicians working on OWF or ONWFs must be well trained and mentally and physically fit to carry out works in safest way possible.

g. The technicians working on OWF or ONWFs must have valid technical qualifications and safety training records.

h. All OWF/ONWF workers must be made aware of the potential for catastrophic failures such as crane failure during lifting of WTG components, or turbine break system failure as a result of not restoring energy isolation devices to the operational position during maintenance, etc.

i. All supervisors overseeing any works at OWFs or ONWFs must be competent in developing, documenting and using detailed technical and safety procedures and applying lockout or tag-out devices to ensure safe practices during service or maintenance activities.

3.2. Events Prompting Inspections, Audits and Assessments

This section covers the events which prompt or should prompt inspections/audits/evaluations. As addressed in Section 2.1 there are a number reportable incidents and accidents, which are experienced more frequently than any other incident and accident types in the wind energy industry. Based on that information risk groups can be categorized which are also shown in Appendix E, which either cause incidents and accidents or aggravate the consequence of incidents or accidents.

a. **Lack of Organization:** The human factor forms the most important risk group as human behaviour and human performance failures are known to cause many incidents and accidents particularly in the absence of adequate SHE system at work, training, work instructions, procedures, process, coordination, risk assessments, first aid systems, emergency and rescue plan, use of Personal Protection Equipment.

b. **Workplace Design:** This risk group presents hazards that cause injuries and fatalities in work areas including places involved in onshore and offshore transfer of WTG components and technicians. Incorrect practices or poorly designed work spaces in WTG, OSP, warehouse or office are known to have caused fall/slip/trip/stumbling accidents with undesirable consequences. Last but not least the confined space is another area which presents major hazard to workers' safety.

c. **Non-compliance with Ergonomic Principles:** This is another area of risk that present hazards particularly with regards to heavy physical work, lighting particularly when working in confined spaces, weather and marine conditions including wind speed, temperature, wave height and currents - particularly for diving operations - for offshore works, lifting and carrying tools and equipment. Non-compliances with any of applicable ergonomic principles are known to result in incidents and accidents.
d. **Mechanical Components:** This risk groups is the second most significant area of hazard for wind farm operations, which are known to cause severe accidents and fatalities over the years. Unguarded machine parts, parts with dangerous surfaces, uncontrolled moving parts and means of carriage have caused a number of accidents that not only caused fatalities and environmental harm, but also sometimes resulted in total loss of asset.
e. **Electrical Components:** This risk group has long presented major hazards on OWF and ONWF sites with shock currents and arcing causing electrocution in WTGs and onshore and offshore substation.
f. **Hazardous Substances:** Harmful effects on health caused by gases, vapours, aerosols, liquid and solid substances are well known. This risk group particularly presents hazards when working in contaminated areas, confined spaces with harmful effects to the skin and lung.
g. **Fires/Explosions:** This is another significant risk group that is addressed in the previous section by giving ample of examples involving WTG fires with severe consequences. The fire hazard is caused due to faulty electrical components, damaged cables, solids, liquids and gases in WTGs, onshore and offshore substations.
h. **Physical Impact:** This risk group presents hazards particularly in the construction phase of OWFs with exposure to noise and vibration during MP foundation installation or decommissioning.
i. **Other Potential Risks and Harmful Effects:** This risk group cover other potential hazards such as psychological strain caused by working at heights, working offshore etc.
j. **Rescue and Emergency Procedures:** This risk group covers risks in the event of emergency when there is not adequate response and rescue procedure and planning in place particularly for incidents necessitating rescue from nacelle of a WTG.
k. **WTG Malfunction:** This risk group is another significant one which is known to have caused a number of severe accidents resulting in loss of lives and entire WTG asset. WTG malfunction may be caused by fault in yaw system, gearbox, bearings, hydraulics, generator, mechanical control etc.

The risks categorized in each group require careful assessments followed by preparation of adequate procedures, processes, work instructions to implement during the transportation, installation, commissioning, operations and decommissioning of OWFs, ONWFs, Met-Mast and onshore and offshore substations. Therefore activities involved in each risk group should be subject to periodic and random internal and external audits to ensure compliance to relevant safety regulations, technical specifications and standards.

Similarly the WTG components that have high failure frequency rate should prompt inspections. As discussed in Section 2.9 “Critical Components of WTGs and Wind Farms”, the most critical components of a WTG are electrical system, gearbox, generator, control system and sensors as failure in any of those components tend to result in malfunction of WTG with potentially severe safety consequences. The other critical components can be categorized in the following groups:

a. Wind Turbine Structure Critical Components:
    i. Tower: Welded steel connections
    ii. Hub: Cast steel
    iii. Blade: Glass fiber reinforce plastics (GPR), carbon fiber, composites
    iv. Nacelle : Steel cast, welded steel connections
    v. Gear Box: Gears, shafts
    vi. Yaw and pitch mechanism: Gears, ring
    vii. Bearings
b. Support Structure:
    i. Transition node: Welded steel connection, grouted connection
    ii. Jacket substructure: Welded steel connections, cast steel nodes
    iii. Tripod substructure: Welded steel connections

Other:

i. Hydraulics
ii. Cables(wind turbine) and Inter Array Cables
iii. Transformer & Converters (Offshore Substation)

As discussed in Section 3.11, a number of WTG components require periodic inspections to ensure asset integrity and to maintain operational availability and safety. It is also discussed which aspects of OWFs should trigger inspections in the Section 3.13. Please see those sections for detailed information about the type of events prompting inspections, audits and assessments.

While it is preferable to follow the risk base inspection approach for a wind farm, any mechanical, structural and/or electrical component failure within a WTG or substation should immediately prompt inspections firstly to determine the root-cause of a failure and secondly to determine the potential failure risk of identical components within other WTGs in the same wind farm. For example, following a major cable failure resulting in fire within one of 15 WTGs in a given wind farm not only the WTG with failed cable should be inspected, but also other 14 WTGs should be checked to determine whether same cable in other WTGs present fire risk.

It is recommended for BSEE to require wind farm owners/operators to demonstrate to BSEE that they have a process in place to trigger inspections on failed components of a WTG, a substation or subsea cables; the inspection should not be only carried out on failed components but they should also be performed on the identical components within the same wind farm in order to prevent same mechanical, electrical or structural faults resulting in similar incidents or accidents.

3.3.Accident Occurrence Probability and Inspection Frequency

This section addresses if or should the probability of an accident occurring affect inspection frequency.

The timing and frequency of inspections should take into account inherent safety, health and environmental risks. Therefore, if it is deemed that the accident occurrence probability is high in any component of a wind farm, then the frequency of the inspections should be increased to address the potential failure modes. This approach resonates with the risk based inspection concept, which is addressed in the Section 2.13.

The probability of accident occurrence is the mean frequency or rate with which the specified accident would be expected to occur in a given period of time, which can be determined based on the historical accident data. Based on the accident occurrence probability, an appropriate written inspection scheme containing the frequency and the nature of inspections should be prepared. Inspection is an initiator for activities such as repair or replacement of equipment, which may have caused accidents in previous occasions, or a change to an operating conditions or a safety procedure, which may have failed to prevent accidents previously. Once the accident occurrence probability is identified, the implementation of risk based inspection with adequate frequency will increase the chances of taking accident mitigation actions, and thereby it will reduce the probability of accidents. As is addressed in different parts of this study, the responsibility of specifying the nature and frequency of inspections and any special measures needed for safe inspections such as implementing lock-out tag-out procedures, selecting appropriate PPEs for inspections works etc. must be placed only with the competent person.

The inspection frequency should be consistent with the accident occurrence probability, which may be associated with a particular WTG component or weather conditions or a safety procedure or adequacy of qualification or validity of training of workers or physical and mental fitness of a worker. While the statutory inspection frequencies are determined by regulatory bodies, non-statutory inspections frequency must be based in various factors. When deciding on an appropriate interval between inspections the relevant factors should be taken into account as there is no single rule in determining the appropriate inspection frequency; this should be decided based on factors such as historical accident data, where available, accident probability, component failure risk, accident severity risk, access to wind farm site – particularly for OWFs - by a competent person with adequate qualifications and experience.

G9 Offshore Wind Health and Safety Association’s 2013 annual incident data report provides much valuable information about the incidents and accidents reported in offshore wind energy industry. Figure 22 below demonstrates that the majority of the reported OWF incidents were related to activities in vessels, WTGs and onshore operations.

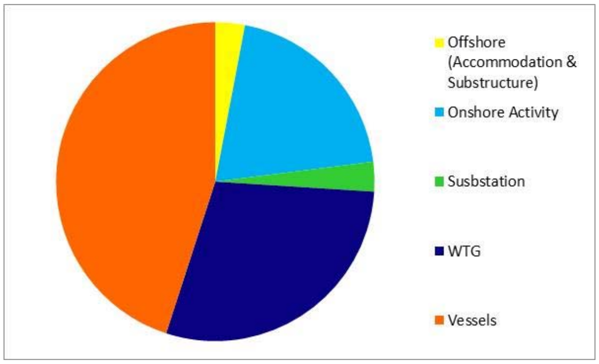
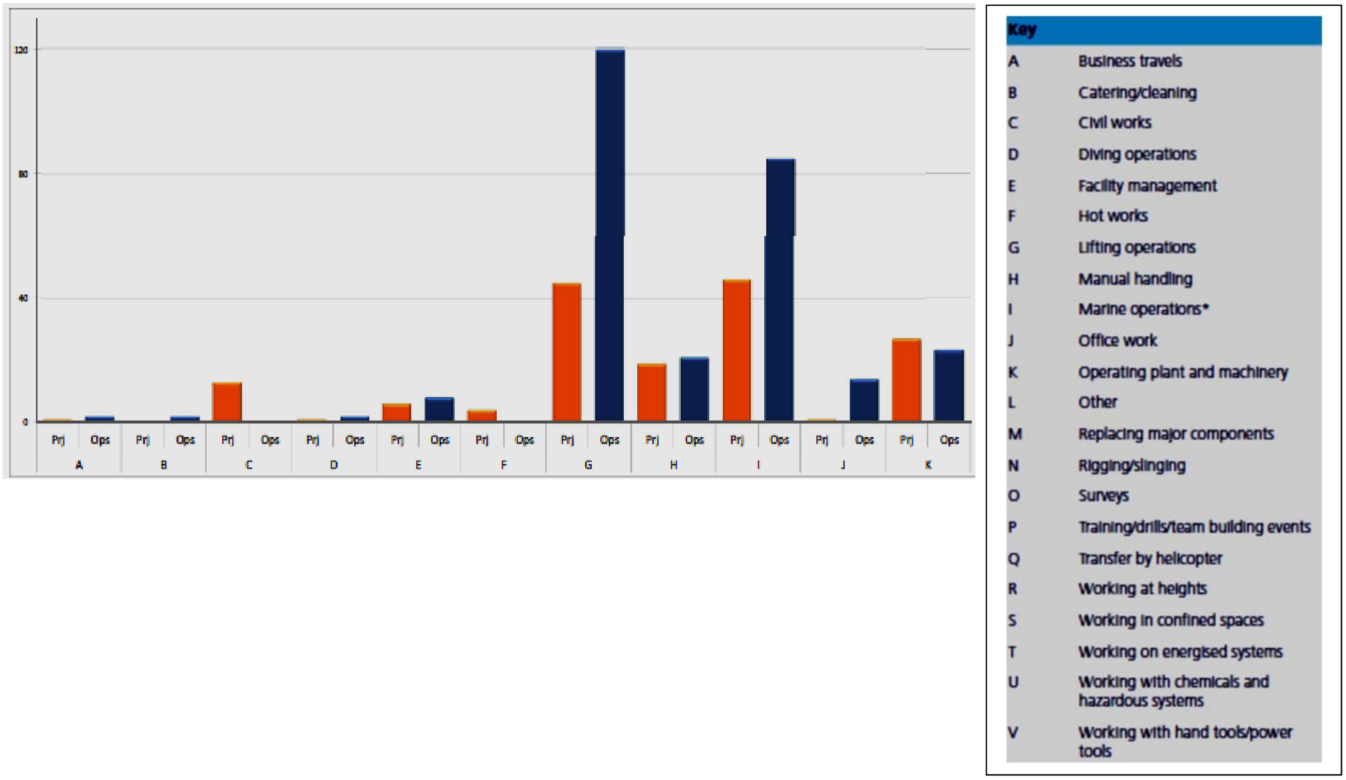


Figure 22 – OWF Incident Area[106]

Likewise Figure 23, which is published in the G9 2013 Annual Data Report, shows the OWF work processes in which accidents occurred in 2013. According to accident data collated by G9 the most of OWF project related accidents happened during lifting operations, marine activities and while operating plant and machinery; similarly the most of OWF O&M related accidents happened during lifting operations, marine activities and while working at heights[107].



[106] G9 Offshore Wind Health and Safety Association 2013 Annual Data Report, page 5, www.g9offshorewind.com

[107] According the G9 statistics the third most frequent accident work-process was classed as "other", which were not taken in to account in the ranking as there was the qualitative information to comment on the work-processes included in this group.

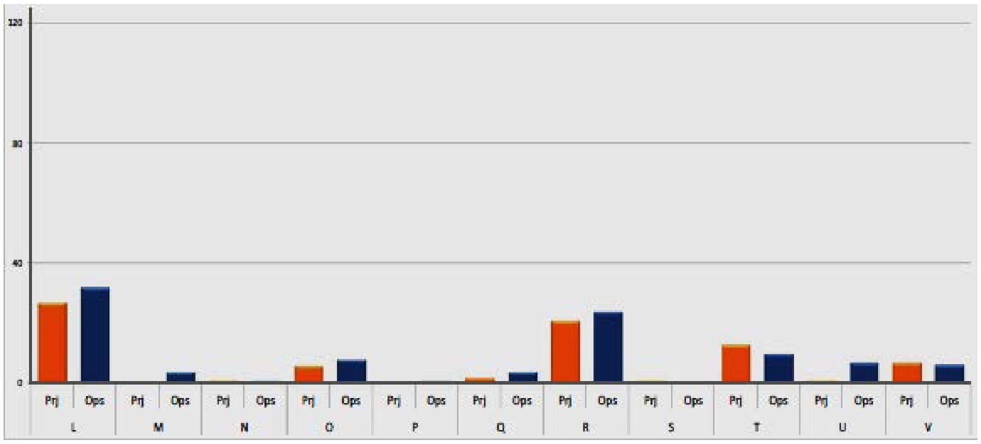


Figure 23 - Work Process – Project/Operation Site Breakdown[108]

Once such accident data is available, it will get easier to estimate the probability of the accident occurrence for OWF or ONWF whether it is in design/transportation/installation/commissioning stage or operational stage. Using probability-impact plots, similar to the one shown in Table 28, it is possible the plot qualitative determine the consequence of a potential accident risk in order to determine the inspection frequency to prevent failure of work-processes, work equipment or components.

	Impact				
Probability	1 (Very Low) Insignificant	2 (Low) Minor	3 (Possible) Moderate	4 (High) Major	5 (Very High) Catastrophic
5 – Very High					
4 - High					
3 - Possible					
2 - Low					
1 – Very Low					

Table 28 – Impact & Probability Relationship

Following the assessment of accident occurrence probability either based on historical approach (by analyzing historical accident records) or on analytical approach (by using probabilistic risk assessment in

[108] G9 Offshore Wind Health and Safety Association 2013 Annual Data Report, page 8, www.g9offshorewind.com

the absence of historical accident database), if it is determined that the potential accident occurrence is likely, it will be necessary to develop an inspection program, which outlines the nature of inspections with requisite frequency.

The relationship between accident occurrence probability and inspection frequency is not always proportional. While in certain occasions there may be a high probability of accident occurrence but with minor consequences, in other occasions there may be a low probability of accident occurrence but with major consequences. Therefore it is rather important to evaluate the correlation between accident occurrence probability and accident consequence before the determining the inspection frequency within a structured OWF or ONWF inspection program.

A risk based OWF or ONWF inspection program should include work procedures, work processes, work instructions, wind farm component parts, which will be all subject to inspections with inspection work scope and inspection frequency. The inspection program, which should be written elaborately, should be critically assessed and reviewed in order to justify the reasons for behind the inspection scheme. In this process the best approach is to apply the risk based inspection principles to determine the frequency, extent and nature of inspections; the following information should be used in this effort:

a. Potential flaws of work instruction, work process or work procedure.
b. Potential mechanisms and rates of deterioration of wind farm components in relation to the length of service.
c. Sites that may be particularly susceptible to deterioration or failure.
d. Potential types of damage, flaws, defects or degradation in equipment.
e. Tolerance of the part to damage, flaws, defects or degradation.
f. The probability or likelihood of failure arising from future operation.
g. The likelihood of risk.
h. The consequences of failure.
i. The risk category of relevant process, procedure, or component

As recommended by the UK Health and Safety Executive, it is a good practice for the written inspection scheme to be reviewed at the time of any repair or modification by a competent person. This review will ensure that the scheme remains valid and that feedback from the repair or modification can be taken into account in establishing the nature, scope, extent or frequency of any future in-service inspection. [109] Although this recommendation is given in accordance with the risk based inspection approach, it also applies to an inspection scheme, which is determined based on accident occurrence probability. It should be remembered that any inspection scheme based on accident risk and/ or other risks should be evaluated periodically as risk profile of a wind farm is changes overtime; therefore any data used to determine the inspection frequency and nature should be reassessed or refined on an ongoing basis.

[109] Best Practice for Risk based Inspection as a Part of Plant Integrity Management, page 53, UK Health and Safety Executive, 2001

3.4.Near-miss Reporting

This section addresses what accidents or near-misses are or should be reported by companies that operate OWFs.

In section 2.22, accidents are grouped which should be reported and elaborated in the accident reporting process. Section 2.23 discusses what type of accidents and near-misses are reported in the wind energy industry. Section 3.1 elaborates on the accidents and near-miss events reported particularly in the offshore wind energy market. The process of accident and near-miss reporting is also addressed. As stated in the relevant sections the accidents and near-miss events should reported promptly; such reports should be completed providing all available details with documented information such as photographs, drawings or sketches and any information regarded as relevant to assist the investigation. The form must be forwarded to the SHE manager or team leader, who is responsible for arranging near-miss investigation. Staff members or contractors should make effort to take appropriate action to rectify or minimize any risk whenever practically and physically possible even before any accident and near-miss report is produced.

The nature of OWFs and the risk involved in the construction and operational phases of OWFs stress the fact that it is crucial to report any accident and near-miss event not only to assess and rectify the root causes but also to increase the safety awareness in order to improve the safety performance in the offshore wind energy industry.

As stated by the UK Health and Safety Executive, the hazards in offshore industry include working from height, slips and trips, contact with moving machinery, possible risks of electrocution or from fire and construction in very windy conditions. Offshore construction is even more hazardous including risks from large waves, diving activities, siting the turbines and issues such as stepping from a boat onto a turbine. Wind turbines also require regular maintenance; therefore workers are exposed to these risks regularly. Additionally, structural failures can occur and turbines are prone to being struck by lightning, which could cause damage and fire[110].

Throughout this study the risks inherent in OWF construction and operation activities are addressed and highlight the inspection requirements to mitigate failures in mechanical, electrical, structural aspects of OWFs. The safety impact of such failures both on people and environment are discussed and highlight the risk of accidents and what should be done to avoid such occurrences. The requirements are laid out for accidents and near-miss events in previous sections. While there are statutory requirements to report OWF accidents and near-miss events in almost all countries - that are included in this study – it is also best practice to report any accident and near-misses to relevant authorities and also share this information with an industry association, where possible, to gather much valuable safety data for improvements.

[110] Horizon Scanning, Wind Energy, The Health and Safety Executive, 2009, UK http://www.hse.gov.uk/horizons/assets/documents/wind-energy.pdf

While it is recommended that all OWF accidents, incidents, near-miss events affecting workers and members of public to be reported, at minimum the following should be reported:

a. Amputation of body parts, cuts and major bruises
b. Asphyxiation due to lack of oxygen in confined space
c. Burns and smoke inhalation in fire
d. Diving accidents
e. Electrical failure incidents or lightning incidents resulting in fire
f. Electrocution or electrical discharge
g. Evacuation of personnel in response to non-weather-related events
h. Eye injuries caused by harmful chemical, welding sparks or other causes
i. Falling into sea, drowning and near-drowning incident
j. Fatal accidents
k. Head injuries
l. Helicopter crash
m. Hit by machinery or objects falling from WTG, cranes,
n. Incidents involving ice throw, rotor blade throw, structural failure resulting in collapse of WTG.
o. Lifting accidents
p. Manual handling accidents
q. Near-miss events including near vessel collision, helicopter misses, PPE defect, dropped objects, exposed live cables, security breach etc.
r. Noise induced hearing loss
s. Power tool, hand-tool accidents
t. Release of hazardous chemicals to soil and ocean
u. Repetitive strain injury
v. Respiratory problems as a result of exposure to harmful substance such as epoxy paint, chemicals or welding fumes
w. Serious injury caused by accidents such as fall from heights, electrocution, transportation, installation, boat landing
x. Transportation accidents onshore
y. Vessel collision with WTG, Met-Mast, OSP and other vessels carrying crew, WTG, foundation, cable

3.5.Metocean Conditions and OWFs

This section addresses which metocean conditions should cause concern for OWF operators, inspectors, and regulators.

The offshore environment can be harsh and it is good practice for wind farm operators, inspectors, and regulators to monitor developing metocean conditions in order to evaluate the suitability and safety of working offshore.

Extreme metocean conditions, which are considered in the design of the wind farm, may pose risks for foundations and turbines, but much more mundane conditions can be hazardous to support vessels and their personnel, as well as inspectors and maintenance professionals working in the field.

At a minimum, the following observed conditions should be monitored/evaluated at the wind farm site before going offshore:

a. Wind Speed and Direction
b. Sea state (wave heights)
c. Visibility
d. Tidal conditions
e. Current speed
f. Temperature
g. Precipitation (snow, sleet, hail, rain)
h. Lightning risk

Weather forecasts should also be considered for planning and continuously monitored to ensure the safety of personnel offshore.

If available a live closed-circuit television (CCTV) broadcast from turbines in the water can provide a much more detailed picture of the conditions aboard individual turbines.

The above items should be considered with respect to guidance from a marine coordination unit responsible for coordination of service vessels and crew, marine equipment, and maintenance technicians.

In addition, the suitability of metocean conditions for maintenance and inspections should also take and take into account the following:

a. Fit for service assessment of vessel for conditions
b. Level of training of personnel/inspectors
c. Safety measures aboard vessels and turbines
d. Conditions of gangways, decks, ladders and walkways aboard the turbines

3.6.Majors Safety Concerns for WTGs, OSPs, Onshore Substations and Transmission Cables

This section addresses the major safety concerns related to WTGs, OSPs (or offshore electrical service platforms), onshore substations, transmission cables and Met-Masts. It also addresses all minimum HSE measures which need to be taken for the inspections of those installations at both onshore and offshore locations.

Like many other industrial assets, offshore substations and onshore substations are also designed with safety aspect in mind in order to meet the statutory safety requirements for structural design, electrical design, fire and explosion protection system design, access and transfer method design while considering the emergency response plan requirements.

A paper published by Thomas Boehme et al[111] explains that one of the first considerations at the design stage of an OSP is the manning level of the platform at the various stages of the project. While most OSPs are unmanned, some OSPs have separate accommodation platforms such as Horns Rev II, as shown in Figure 24, which is connected to the transformer platform by a bridge. Another example is the Bard Offshore I OSP, as shown in Figure 25, which adopted an approached used in the oil and gas industry where equipment and accommodation are located on the same offshore transformer platform. So it is not entirely correct to refer to OWF asset as unmanned as some of the OSPs are designed to accommodate workers offshore.

Figure 24 – Horns Rev II OSP with Accommodation Platform[112]

[111] Offshore Transformer Platform Design for Safety, Thomas Boehme, Lars Schiøtt Sørensen, James Brown, and David Boye, European Wind Energy Association, Stockholm, 2009 http://proceedings.ewea.org/offshore2009/allfiles2/214_EOW2009presentation.pdf

[112] http://www.4coffshore.com/windfarms/substation-horns-rev-2-substation-sid111.html

Figure 25 – Bard Offshore I OSP[113]

The following aspects of OSPs are taken into consideration when identifying and assessing risk in the risk management process:

- Crew transfer by boat and helicopter
- Access and exit routes for emergency response
- Structural integrity of top side and substructure
- Transformer, electrical equipment and cables
- Fire and explosion protection system

The main safety concerns related to onshore substations, shown in Figure 26, are mainly associated with integrity of substation, transformer, electrical equipment and cables. In addition to those main components, the following aspects of onshore substations are included in the safety risk assessment:

a. Foundations, including oil sumps
b. Buildings
c. Cable ducts
d. Fencing/access control
e. Lightning protection
f. Main and auxiliary transformers
g. Relay coordination
h. Low Voltage systems (LVAC, LVDC, UPS)
i. Earthing system
j. VAR compensation

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[113] http://www.4coffshore.com/windfarms/substation-bard-1-substation--sid101.html

Based on those components substation safety equipment are normally installed at each switch-room location; the equipment includes the following:

a. Safety and warning signage
b. Insulating matting and/or platforms
c. Lifesaving or intervention kits (portable or wall mounted)
d. Voltage detectors
e. Earthing kits

Figure 26 – London Array Onshore Substation[114]

On the basis of national and international health and safety at work regulations, companies are legally required to identify the hazards associated with any workplace, to assess the risk, to stipulate safety measures and to verify the effectiveness of the safety measures taken for wind farms. This rule also applies to all workplaces not only to the company premises, but also to temporary workplaces, such as warehouses, factories, construction sites and wind farms.

Inspecting OWF and ONWF installations including OSP and Met-Mast is subject to a multitude of potential hazards. Therefore inspections must only be carried out after all requisite safety precautions are taken. This section specifies those safety measures, which need to be complied with and implemented in order to ensure safe inspection practices.

Despite numerous engineering safety measures, inspecting WTGs, OSPs and Met-Mast still involves many hazards. Therefore protecting inspectors against hazards not only requires the use of PPE but also safe conduct, which basically requires knowledge of the potential hazards and the necessary safety measures.

3.6.1. Risk Management System

One of the first requirements for safe inspection practices is to perform documented risk identification for all inspections related activities. In fact this practice is regulated by the relevant national and international regulations, such as EU directive 89/391/EC[115]. The aim of this Directive, which resonates

[114] http://www.londonarray.com/about-us-2/onshore-substation/

[115] Directive 89/391/EEC - OSH "Framework Directive", European Agency for Safety and Health at Work,

with similar regulations around the world, is to introduce measures to encourage improvements in the safety and health of workers at work. The EU Directive states that, "*It is of fundamental importance as it the basic safety and health legal act which lays down general principles concerning the prevention and protection of workers against occupational accidents and diseases. It contains principles concerning the prevention of risks, the protection of safety and health, the assessment of risks, the elimination of risks and accident factors, the informing, consultation and balanced participation and training of workers and their representatives*".

The EU Directive 89/391/EC adequately addresses the documented risk identification process which must be carried out before undertaking any inspection works on WTGs, OSPs and Met-Masts and other wind farm related assets. The process put together in the EU Directive is commonly applied for wind farm inspections in Europe.

The EU Framework Directive contains basic obligations for employers and workers, but also states, "Nevertheless, the workers' obligations shall not affect the principle of the responsibility of the employer. It is the employer's obligation to ensure the safety and health of workers in every aspect related to work and he may not impose financial costs to the workers to achieve this aim. Alike, where an employer enlists competent external services or persons, this shall not discharge him from his responsibilities in this area."

The EU Directive lists the general principles of prevention as following and also outlines the obligations of employers and workers:

a. Avoiding risks
b. Evaluating the risks
c. Combating the risks at source
d. Adapting the work to the individual
e. Adapting to technical progress
f. Replacing the dangerous by the non- or the less dangerous
g. Developing a coherent overall prevention policy
h. Prioritizing collective protective measures (over individual protective measures)
i. Giving appropriate instructions to the workers

The employer shall:

a. Evaluate all the risks to the safety and health of workers, inter alia in the choice of work equipment, the chemical substances or preparations used, and the fitting-out of work places.
b. Implement measures which assure an improvement in the level of protection afforded to workers and are integrated into all the activities of the undertaking and/or establishment at all hierarchical levels.

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https://osha.europa.eu/en/legislation/directives/the-osh-framework-directive/1

c. Take into consideration the worker's capabilities as regards health and safety when s/he entrusts tasks to workers.
d. Consult workers on introduction of new technologies.
e. Designate workers to carry out activities related to the protection and prevention of occupational risks.
f. Take the necessary measures for first aid, fire-fighting, evacuation of workers and action required in the event of serious and imminent danger.
g. Keep a list of occupational accidents and draw up reports for the responsible authorities on occupational accidents suffered by his workers.
h. Inform and consult workers and allow them to take part in discussions on all questions relating to safety and health at work;
i. Ensure that each worker receives adequate safety and health training

The worker shall:

a. Make correct use of machinery, apparatus, tools, dangerous substances, transport equipment, other means of production and personal protective equipment
b. Immediately inform the employer of any work situation presenting a serious and immediate danger and of any shortcomings in the protection arrangements
c. Cooperate with the employer in fulfilling any requirements imposed for the protection of health and safety and in enabling him to ensure that the working environment and working conditions are safe and pose no risks.

This risk identification must be carried out based on the most up-to-date knowledge and relevant regulations. On completion of this process further amendments and updates will be necessary to respond to the most up-to-date findings and changing hazards in inspection works. This risk identification and assessment should be viewed in the light of the emergency and rescue procedures in connection with the rescue and emergency program for WTGs, OSPs and Met-Mast.

Following this risk identification and assessment process, significant risks or hazards may require specific work-related hazard assessment in order to ensure safe inspection activities. While it is important to identify all inherent risks in inspection activities, it is equally important to assess the impact of uncontrollable risk such as the weather in order to take effective safety measures.

The most significant hazards identified when working on wind farm assets are listed below and shown in Figure 27:

a. Danger of falling: When climbing up/down in the tower or inspection components at height
b. Electrical danger: When working on electrical equipment
c. Danger due to weather conditions: When strong winds, high waves, bad weather conditions, ice and snow are prevalent
d. Danger due to falling objects: When tools and equipment positioned at height are not properly secured

e. Danger due to falling or stumbling: When working on WTG, OSP or Met-Mast
f. Danger due to rotating machine parts: When working within range of the drive shaft
g. Danger due to physical load: When climbing ladders in or on WTG, OSP and Met-Mast
h. Danger due to faulty operation: When flawed operation of the wind turbine controls or electrical components in OSP is experienced
i. Danger due to suspension trauma: When individual immobilised in harness or rope when inspecting blades or working in WTG
j. Danger due to delayed rescue: When accident occurs in the tower or nacelle
k. Danger due to lack of escape route: When smoke formation in WTG or OSP
l. Danger due to confined spaces: When working in the hub, rotor blade or under watertight platform of offshore monopile foundation

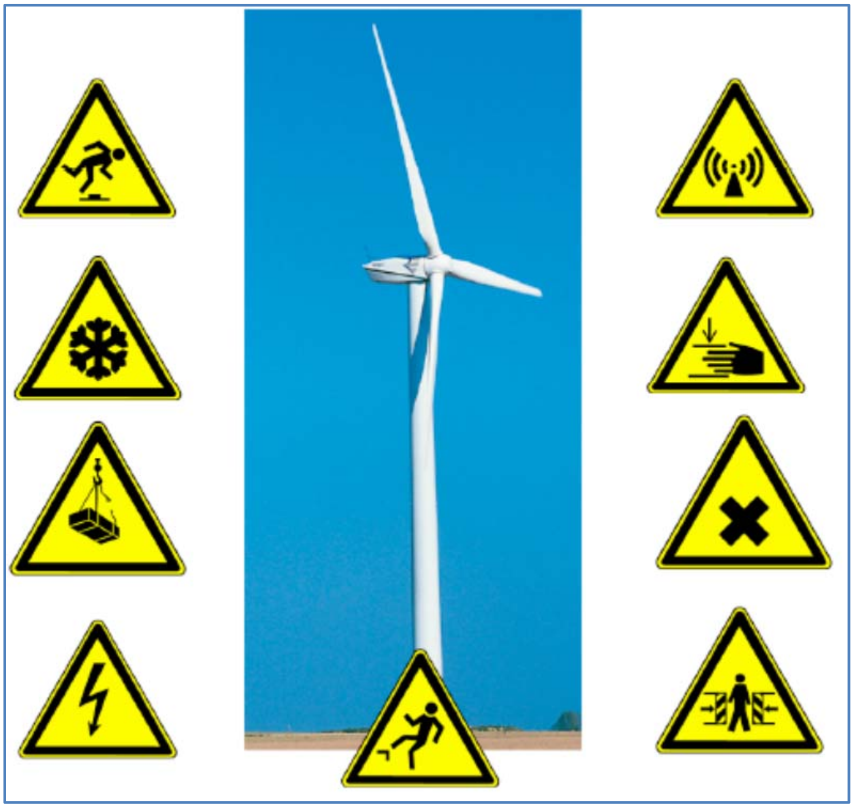

Figure 27 – Work Hazards on WTGs

3.6.2. Working in Confined Space

As discussed in section 2.1.7, working in confined space has special requirements. Those requirements were developed over the years to address accidents which occurred while working in confined spaces. As mentioned earlier, a confined space is any space with difficult access and exit and restricted natural ventilation. There are two areas that are classified as confined spaces in wind farms:

a. The interior of the WTG rotor blade: This area remains a confined space irrespective of whether it is in the manufacturing facility, being installed or already assembled as part of a WTG.
b. Below the airtight deck of an offshore WTG foundation: This area is classified as confined space.

In many developed countries, accessing and working in confined spaces are only permitted for workers who have valid confined space training certificates. Particularly in Europe, there are several training companies that offer WTG specific confined space training programs. Whether the inspections or maintenance works are to be performed in a rotor blade or below airtight deck of an offshore foundation, it is a must to prepare a risk assessment method statement (RAMS) prior to commencing any works in those confined spaces. In many countries this is a legal requirement.

As for carrying out any inspections and maintenance works in rotor blade or below the airtight deck of an offshore WTG foundation, RAMS must be prepared. RAMS must have detailed description of tasks to be carried out and qualitative and quantitative risk assessment including control measures and conclusions. The risk assessment must considers the risks arising from each of the identified hazards, and set out the risk preventative measures, which are required to reduce those risks to the lowest reasonably practicable level. While carrying risk assessment the following should be addressed:

a. Risk identification
b. Potential harm
c. Risk location
d. Persons at risk
e. Risk rating before putting controls in place
f. Control measures
g. Residual risk rating after putting controls in place

In this process it should be recognized that solving one risk problem can create another, and that there are practical issues that need to be taken into account. The risk assessment must take into account the local regulations, HSE management system requirements of wind farm owner and/or operator. Similar to any other requirements for working at OWF, ONWF, OSP or Met-Mast, the RAMS should address requirements for PPE, signaling, Organization and supervision and emergency response plan.

In addition to assessment of environmental conditions and fitness of workers/inspectors, which must be evaluated for carrying out works below airtight deck, when it comes to internal rotor blade inspections, the rotor blade geometric requirements (for accessing and working in blade) should also be considered when preparing risk assessment method statements. There are two important dimensions for work within a rotor blade[116]:

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[116] Working in Confined Spaces-Best Practice Guide-Blades, Asociacion Empresarial Eolica (The Spanish Wind Energy Association), 2012, Spain http://www.aeeolica.org/uploads/documents/4160-working-in-confined-spaces-best-practice-guide-blades.pdf

a. The scale of the work: This is what enables the worker to carry out some tasks inside the blade. The whole of the blade is not accessible, as it is very narrow at the tip. Some blades, particularly those on less powerful turbines, are not accessible at all,
b. The size of the manhole giving access to the interior of the blade.

Working within the rotor blade requires specific dimensions as shown in the EN 547 standard:

a. The average thickness of the human body for a horizontal opening in an out-stretched position (95 percentile) = 342 mm
b. Dimension of elbow width = 545 mm

The supplements stipulated in the EN 547 standard should be added to these dimensions:

a. Use of personal protective equipment = 100 mm
b. Work clothing = 20 mm
c. Free space for arm movements = 20 mm

Therefore, the minimum size for a worker using work clothing and personal protective equipment and needing minimum arm movement would be 482 x 685 to be able to carrying out any inspections or repair works inside a rotor blade. In the absence of these dimensions, it is recommended that work should be performed on the ground in order to avoid the body being trapped in the blade, from where rescue would be extremely difficult.

As for the dimensions of manhole for rotor blade egress or airtight deck egress, the EN 547 standard[117] stipulates the following dimensions:

a. 342 x 545 mm for oval openings
b. 50mm are added for free space of access

Therefore the resulting minimum dimensions are 392 x 595 mm for oval openings. These dimensions coincide with the established in EN50308 standard (standard not harmonized) 400 x 600 mm. For circular openings it´s accepted until 500 mm in diameter as minimum, but it has to take into account that the access will be very difficult. In that case it is recommended a minimum diameter of 550 mm[118].

Occupational health monitoring is particularly important for workers who need to carry out inspection or maintenance service in confined spaces within wind farms. Occupational health monitoring protocols for working in confined spaces focus on:

a. Behavior regarding claustrophobia, stress
b. Health conditions regarding cardiac conditions, epilepsy, diabetes

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117 https://law.resource.org/pub/bg/ibr/bds.en.547-3.1996.a1.2008.pdf or http://shop.bsigroup.com/ProductDetail/?pid=000000000030179189

118 http://shop.bsigroup.com/ProductDetail/?pid=000000000030143430

c. Vertigo when working at height
d. Extreme physical exertion
e. Dermatological tolerance for blade inspectors and repair workers when checking resins, fiberglass and catalysts

3.6.3. Working at Heights

Accidents involving falls from heights still continue to be one the major causes for accidents and most serious injuries, sometimes resulting in fatalities in the wind energy sector. In recent years, falls from heights constituted one of the major causes for fatalities in wind farm projects and operational assets in Europe.

Working at height, whether in a WTG or OSP or on Met-Mast, presents risk of falling as the improved designs of those installations cannot completely eliminate the risk of falling. Even though the safety engineering has enhanced the safety aspect of installations in WTGs, OPS and Met-Mast by introducing robust and ergonomic design including interface between ladders and hatches, guardrails and safety barriers, etc., the correct use of PPE has proven to be vital in ensuring safe working practices at heights and most countries made the use of relevant PPE compulsory.

Therefore, it is very important to ensure that fully functional and adequate PPE are used when working at heights in WTGs, OSPs, Met-Mast and onshore substation. With regard to those installations, PPE must be used in the following areas or operations:

a. Entry into and exit from the vertical fixed rail fall arrest system.
b. Work on open nacelle
c. Work on nacelle roof (e.g., working on anemometer)
d. Work on Met-Mast
e. Work within hub area
f. Work on rotor blade
g. Work with electrical equipment and cables
h. Evacuation from the nacelle

The employer or its contractor has the obligation to make the necessary fall arrest PPE available to the inspectors and workers and to instruct them appropriately. In return the inspectors and the workers have the obligation to use the fall arrest PPE provided to them in accordance with the instructions.

The following are the basic requirements for the use of fall arrest PPE when working at heights whether in a WTG or OSP or on a Met-Mast:

a. Any person working in fall risk areas must undergo regular medical examinations.
b. Risk identification and assessment must be performed prior to use of fall arrest PPE.
c. Assess hazards resulting from the fall arrest PPE (i.e., misuse of the PPE or poor maintenance of PPE resulting in malfunction of fall arrest PPE).
d. The fall arrest PPE must be accompanied by operating instructions.
e. The fall arrest PPE must be used in accordance with the instructions and its intended use.

f. Inspectors and workers must be trained in appropriate use of the fall arrest PPE.
g. Refresher training must take place at least once a year or when necessary.
h. The fall arrest PPE training course for inspectors and workers must cover both the theoretical and practical aspects of the field of application, and if necessary, also include the essential rescue measures.
i. When fall arrest PPE is used, inspectors and workers must never work alone (as lone working is not permitted), because it is paramount to ensure instant rescue of the injured by the second person in case of an emergency.
j. Only use safe fall arrest PPE which is fit for the purpose.
k. The fall arrest PPE maintenance must be documented.
l. The fall arrest PPE must not be misused for other purposes, for example, for transporting loads.
m. A fall into the fall arrest system is always dangerous despite energy absorption, and therefore the safeguard should be put in place to minimize the risk of falls.
n. The PPE must not be exposed to factors that can affect the safety conditions of the PPE. The following could have a detrimental effect on fall arrest PPE:
    i. Acidic/alkaline solutions
    ii. Contact/friction heat
    iii. Flying sparks

The following fall arrest PPE requirements must also be taken into account when assessing whether fall arrest PPE is fit for purpose:

a. Only CE mark/American National Standard Institute (ANSI) certified equipment must be used.
b. The PPE must be used in accordance with the manufacturer's instructions and its intended use.
c. Safety-relevant modifications (such as knots) to the PPE are strictly forbidden; therefore modify PPE must be taken out of use at once.
d. Prior to each use, the user of fall arrest PPE must check the PPE for any damage, wear and tear or other safety-relevant defects.
e. If the PPE is damaged or its functionality is deteriorated as a result of wear or tear or a strain caused by a previous fall, the PPE must be withdrawn from use, until a competent person approves its further use after an appropriate inspection.
f. Any defect in a fall arrest PPE must be reported to the safety person in charge.
g. The fall arrest PPE must be inspected every 6 months by accredited inspection firm and inspection records must be issued for filing.

3.6.4. Safety Requirements

In order to ensure safety of people and environment, any inspections or work carried out at OWF and ONWFs must only be performed by qualified workers with necessary work tools and PPE. Anyone, who is assigned to carry out inspections at WTG, OSP, Met-Mast, onshore substation or on transmission cables, must have requisite qualifications and valid safety training certificates. Table 29 below shows the safety qualification matrix implemented in many European countries for inspectors:

Safety Qualification Matrix	Inspection Onshore WTG & Substation	Inspection Offshore WTG & Substation	Inspection Rope Access Onshore	Inspection Rope Access Offshore	Transmission Cables
Company medical examination	Required	Required	Required	Required	Required
First Aider	Required	Required	Required	Required	Required
Basic Training Fall Arrest PPE/ Rescue PPE	Required	Required	Required	Required	n/a
First Aid/Rescue	Compulsory	Required	Compulsory	Required	Required
Offshore BOSIET Course	n/a	Required	n/a	Required	Required for offshore
Helicopter Training/Winch Training	n/a	Required	n/a	Required	Required for offshore
Specialist/Qualified Person Fall arrest PPE	Required	Required	Required	Required	n/a
Rope Access - Level 1	n/a	n/a	Required	Required	n/a
Rope Access - Level 2	n/a	n/a	Required	n/a	n/a
Rope Access - Level 3	n/a	n/a	Required (one person per team)	Required (one person per team)	n/a
Electrical Control Equipment Qualification Course	Required	Required	n/a	n/a	Required
Person Qualified in Electrics/Equipment-related Training	Required	Required	Required	Required	Required

Table 29 – Safety Qualification Matrix for Inspectors

Table 30 below demonstrates additional information regarding average duration of safety training course and validity of safety training qualifications. All safety training qualifications must be documented for the records and individual certificates such as safety passes must be issued to the inspectors.

Safety Training Courses	Description	Duration	Refresher Training
Company medical examination	Medically approved by company doctor	variable	Every 36 months or when necessary
First Aider	First aid training	16 h	Every 24 months Refresher
Basic Training Basic Training Fall Arrest PPE/ Rescue PPE	Safety training on WTI, use of fall arrest PPE, emergency measures, rescue, evacuation	16 h	Every 12 months
First Aid/Rescue	Training in more specialised emergency measures and rescue	24 h	Every 12 months
Offshore BOSIET Course	Offshore safety course	24 h	Every 36 months
Helicopter Training/Winch Training	Helicopter safety training	8 h	Every 12 months
Specialist/Qualified Person in Fall arrest PPE	Qualified to inspect fall arrest PPE and vertical fixed rail fall arrest systems in the WTI	24 h	Every 12 months Refresher course
Rope Access - Level 1	Basic training in rope assisted access and operational techniques	5 days	Every 12 months Refresher course
Rope Access - Level 2	Intermediate training in rope assisted access and operational techniques	5 days	Every 12 months Refresher course
Rope Access - Level 3	Training for supervisory worker at	5 days	Every 12 months

Safety Training Courses	Description	Duration	Refresher Training
	heights for rope assisted access and operational techniques		Refresher course
Electrical Control Equipment Qualification Course	Qualification to perform electrical control operations	24 h	Every 24 months
Person Qualified in Electrics/Equipment-related Training	Safety training for electrical operating rooms	8 h	Every 24 months

Table 30 – Additional Information about Safety Qualification

3.6.5. Safety of WTG

It is of a great importance that wind turbine generator, offshore substation, onshore substation or Met-Mast is in a safe state in order to perform inspections safely. Likewise if subsea inspections are to be carried out by diving to ascertain the condition of transmission cable, it is paramount that such inspections are only carried out when the weather conditions and the sea state (including wave heights, currents, water temperatures) are conducive to safe under water inspections. Therefore the following must be insured prior to commencing any inspection works on wind farm installations:

a. During the construction phase, the wind farm components must be installed accordance with the manufacturer's installation requirements and also in compliance with recognized standards and applicable regulations to ensure safety.
b. The asset operator/owner is responsible for the operation and safety of wind farm installations and therefore must take all precautions for safe inspection practices.
c. Any deviation from safe operation practices must be promptly reported to relevant authorities to prevent major safety hazards to inspectors, workers and environment. Therefore strict compliance with the safety and operating instructions (as outlined in the operating manuals) of the WTG, OPS, Met-Mast or onshore substation component manufacturers' must be ensured.
d. All safety installations of the wind farm installations must at least comply with the local safety legislation requirements.
e. All safety-relevant systems of the wind farm components must be fully operational.
f. All anchorage points for the use of fall arrest PPE must be inspected and identified periodically.

g. Installed fall arrest systems must comply with a local standard such as BS EN 353-1:2002[119] in the UK and must be inspected on a regular basis in accordingly.
h. Wind turbine generator, offshore substation, onshore substation or Met-Mast must be equipped with the necessary safety signs.
i. Wind turbine generator, offshore substation, onshore substation or Met-Mast must be equipped with the necessary safety equipment:
    i. Fire extinguisher
    ii. First aid kit
    iii. Rescue equipment
j. The lift, where applicable, must only be used by specially trained personnel.
k. Any type of crane must only be used by specially trained personnel.

3.6.6. Safety Measures

Over the years the advancements made in safety engineering have improved a number of safety measures, but inspecting wind farm installations and substations still continues to be a very risky activity and it is hence very important to ensure that adequate safety measures are put in place prior to commencement of any inspection works whether in WTGs or in OSPs or under water checking transmission cables. Therefore it is vital that the following safety aspects are taken into account when performing inspections in WTGs, OSPs, Met-Masts, onshore substations or under water:

a. Comply with the manufacturer's and operator's safety instructions.
b. Inspections must only be carried out by suitably trained and qualified persons.
c. Only medically approved staff (company medical examination) is authorized to access OWF and ONWF installations. In this context, it is also necessary to take into account the worker's physical condition on the day.
d. Working in isolation is strictly forbidden on wind turbines. Emergency and rescue procedures must at all times be ensured by fellow team members.
e. In order to identify emergency situations in timely fashion, workers must constantly remain within calling distance and in visual contact, or be in radio contact.
f. All workers working on a wind turbine installation must be able to make an emergency call at all times using mobile phone or radio equipment.
g. The manager in charge must appoint one suitably qualified worker within the team as the on-site supervisor.
h. Reliable operational communication must be ensured between the inspectors and other staff on duty. If radio equipment is used, this must be checked prior to ascending.
i. Prior to undertaking any inspections, the inspectors must ensure that the wind turbine or substation is made safe and secured against accidentally starting up again. Depending on the

[119] BS EN 353-1:2002, PPE against falls from a height. Guided type fall arresters including a rigid anchor line,

http://shop.bsigroup.com/ProductDetail/?pid=000000000030129490 work to be carried out in a WTG, the yaw mechanism and the rotor blade must be immobilised by using correct procedures.

j. WTG, OSP, Met-Mast or onshore substation must be secured against any unauthorised access.
k. WTGs must only be ascended by means of fully reliable safety equipment (vertical fixed rail fall arrest system, anchoring points). If the safety equipment is not entirely safe to operate or incomplete, the installation must only be accessed by workers who are suitably qualified to ensure safety by other means (i.e. anchorage using connectors, anchorage to temporary anchorage points).
l. Access to a WTG which is in full operation is only authorised in exceptional cases and subject to compliance with special safety measures.
m. When it is unavoidable to spend time in a nacelle while the turbine is operational if for fault detection purposes or for taking readings, all necessary precautions must be taken to mitigate all hazards.
n. Prior to commencement of inspections, the remote surveillance unit of the manufacturer and the operator must be informed of the start and end of the inspection works.
o. In areas where there is a risk of falling, permanent safety anchorage is necessary by means of specially designed fall arrest PPE. This measure must be complied especially when connecting to or disconnecting from the vertical fixed rail fall arrest equipment, which must be preceded by first attaching by means of a connector.
p. Inspectors must only use their fall arrest PPE when it is safe to do so. The safety of fall arrest PPE must be checked by the workers prior to each use.
q. Regardless of the first aid equipment, which must be made available in WTG or at the Met-Mast, each inspector must carry their own small first aid kit in their fall arrest harness.
r. Working under the influence of alcohol (this also applies to residual alcohol), drugs or any medication impairing one's abilities of perception and performance is strictly forbidden.
s. In order to avoid any danger caused by falling objects, all objects carried (e.g. tools and materials) during ascent must be secured accordingly. This can be ensured, for example, by transporting those items in a suitably secured bag.
t. The vertical fixed rail fall arrest equipment of the WTG must only be used with the specially authorised fall arrest runner.
u. Work on a WTG is strictly forbidden in thunderstorms. If thunderstorm risk prevails after ascending a WTG, the inspector must evacuate immediately.
v. Depending on the works to be carried out, the inspector should take into account the risk of strong winds, and this particularly applies to works in the nacelle, the hub and within range of the rotor.
w. In bad weather conditions the inspector must also take into account the risk of falling ice; this applies to the area below the WTI and particularly for installations with an open nacelle.
x. When working at different levels, the inspector must take into account the risk of falling objects.
y. Safety equipment must only be dismantled or removed in exceptional circumstances while carrying out inspections. If that becomes unavoidable then the inspector must take extreme safety precautions to prevent accidents.

z. Full danger signage in WTG, OSP, Met-Mast and onshore substation must be available and meet all standards and regulatory requirements.
aa. The inspectors must be trained in the use of WTG lifts.
bb. Only suitably qualified workers are authorised to operate the cargo crane and access the transformer room.
cc. The size of the inspection team will depend on the potential hazard. Offshore inspections require at least three qualified people to ensure safe working practices.
dd. The inspectors must be physically strong, fit and in good physical and mental condition.
ee. The inspectors must attend a refresher course once a year to update their safety-relevant knowledge, upon which they get also examined.
ff. Every inspection task will be the subject of a specific, subject-related risk identification and assessment exercise by the supervisor in charge.
gg. The on-site supervisor in charge is responsible for taking any safety-relevant decisions with regard to the actual execution of inspections, which will be risk based.
hh. Inspections on electrical equipment (high voltage or low voltage) must only be performed by specially trained inspectors, who must comply with all necessary safety measures including the following:
    a. Switch off the power
    b. Check the power to ensure it is switched off and there is no voltage
    c. Secure against switching on again
    d. Cover other neighbouring equipment which is still live
ii. When using hazardous substances, all the necessary safety measures and appropriate code of conduct must be observed in accordance with the manufacturer's instructions. If necessary, inspectors must wear the appropriate PPE.
jj. Inspectors must comply with all necessary fire safety measures.
kk. Inspectors must comply with all the necessary emergency and rescue procedures when working in WTGs, OSPs, Met-Masts, onshore substations or under water for cable inspections
ll. Wind Farm installations owner must ensure that the appropriate safety equipment (rescue equipment/fire extinguishers/first aid equipment etc.) is made available and ready for use during inspections.
mm. All inspectors who are required to work in WTGs, OSPs, Met-Masts, onshore substations or under water must hold the necessary qualifications with regard to safety issues and emergency and rescue procedures.
nn. In order to ensure safe evacuation in the event of smoke forming in the tower or in the substation, inspectors must ensure their escape route by means of rescue equipment.
oo. If a WTG gets out of control during inspections, as such that it can no longer be controlled by the operating controls, all persons must immediately evacuate the WTG and keep at a sufficiently safe distance from the WTG after evacuation.

It should be noted that the list above is not an exhaustive list of all the safety-relevant issues which may arise in practice. Depending on the situation and the nature of the inspection works, further safety procedures and appropriate code of conduct may need to be put in place. This can be achieved by carrying out adequate task based risk assessments prior to any inspection works and by ensuring compliance with the national and international safety rules and regulations as well as with the manufacturer's safety instructions.

3.6.7. Specific Safety Procedures for Offshore Wind Turbines

One of the highest hazard activities for OWF installations is the offshore transportation. Prior to arranging transfer to an offshore WTG, OSP or Met-Mast, the task-specific Risk Assessment Method Statements (RAMS) must be carried out. The RAMS must address the following points:

a. Weather conditions (current/forecast for the duration of the work)
b. Means of transport (Helicopter/Boat)
c. Procedures for offshore rescue (chain of offshore survival)
d. Training status and size of the team
e. Task description and method statements
f. Scheduled duration of work
g. Risk identification and risk assessments

On the basis of the task-specific risk assessments, a decision will subsequently be taken on the feasibility of the planned offshore works. Following the risk assessment method statement any offshore work must only be approved when the following points are adequately addresses and confirmed for safe offshore transfer and operations.

a. Safe transport to and from the WTG, OSP or Met-Mast is ensured.
b. The chain of offshore rescue procedures for all possible emergencies is in place.
c. Training status and team size meet the safety-relevant regulations.
d. The outcome of risk assessments is positive as such that the offshore transfer and offshore works can take place safely.

3.6.8. Emergency and Rescue

In the case of emergency on wind farm installations, the inspectors and workers must be able to immediately implement the necessary procedures. Typical incidents that constitute emergency situation are listed below.

a. Injuries
b. Fall while using the fall arrest PPE
c. Acute medical conditions such as heart attack
d. Exhaustion
e. Technical problems resulting in entrapment of a worker
f. Electrical shock
g. Burns
h. Smoke/ toxic gas inhalation

As it is in the event of an injury, being suspended in the fall arrest harness will also cause risk of bodily harm. When a person working at heights gets suspended freely or from a vertical fixed rail fall arrest system and gets immobilized in the harness, there is an immediate risk of suspension trauma, because reduced blood circulation can quickly lead to loss of consciousness, and if not rescued the person may suffer heart and blood circulation failure.

The safety rules governing the use of fall arrest PPE stipulate that no person should ever remain suspended in a harness for more than 20 minutes. In fact the recent findings on the suspension trauma process have clearly demonstrated that loss of consciousness can already set in within a significantly shorter space of time (less than 10 minutes). Due to this problem it is crucial that, as a primary rescue, the rescue team members must remove the suspended person from suspended position as soon as possible even before the other rescue services arrive, e.g. the fire brigade and ambulance service. It is important to remember that failure to rescue the suspended person swiftly may result in undesirable outcome as too much time valuable will be lost while waiting for fire brigade to arrive. Therefore it is very important to ensure compliance with the following points with regards to emergency and rescue procedures when using fall arrest PPE:

a. Lone working (working in isolation) is not permitted when working on WTG, OSP or Met-Mast.
b. At least a team of three people for accessing an offshore wind turbine is mandatory.
c. A crew transfer vessel must stay within calling distance and maintaining visual contact while working on WTG, OSP or Met-Mast in order to recognize and respond to any emergency situations immediately.
d. A reliable communication method such as mobile phone or radio equipment is made available to inspectors/technicians when working on WTG, OSP or Met-Mast in order to be able to make an emergency call promptly.
e. The appropriate and fully functional rescue equipment must be available.
f. The team must be fully conversant with the necessary rescue techniques.

The following section addresses the important aspects of rescue process to ensure most effective rescue operations from WTG, OSP, onshore substation or Met-Mast, as applicable.

3.6.8.1. Chain of Rescue Procedures (Chain of Survival)

An effective chain of rescue procedures must be put in place for all wind farm installations including WTG, OSP, Met-Mast and onshore substation regardless of their location. While the wind farm owner or the operator is responsible for putting the chain of rescue procedures in place in accordance with the federal, state and international safety regulations, anyone working on wind farm installations is also responsible for following the chain of rescue procedures. In this process, the following points must be ensured:

a. In case of an emergency, the workers must be able to make an immediate emergency call using mobile phone or radio equipment.
b. The exact location of the wind farm installations must be communicated to the emergency response teams in advance.

c. Special rescue forces (rescue at heights) must be alerted.
d. The appropriate signage must be available in WTG, OSP, Met-Mast and onshore substation.
e. The wind farm installation must only be accessed when an up to date chain of rescue procedures is in place.
f. All persons working on wind farm installations must be familiar with the necessary procedures to activate the chain of survival.
g. For OWF installations, offshore survival procedures and offshore emergency and rescue plans must also be complied with.

3.6.8.2. Rescue Equipment

Special rescue equipment, which should comply with applicable regulations such as OSHA 29 CRF Part 1926 Subpart M Fall Protection, ANSI Z359 Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components, CSA Z259 Descent Control Devices, BS EN 341:2011 Personal Fall Protection Equipment – Descender Devices for Rescue,[120] must be used to facilitate a rescue from fall arrest PPE and to evacuate from WTG or Met-Mast in the case of an emergency. Special rescue equipment is used for the following purposes:

a. Roping down of a person to be rescued.
b. Roping up/lifting a person to be rescued
c. Evacuation in an emergency such as fire/smoke development

A complete rescue equipment is fitted with centrifugal force brakes, which enables the roping down process to take place independently from the controls at a fixed speed, generally within a range of 0.7-0.9 meter per second (m/s). This equipment also has a lifting function, which makes it possible to lift the injured out of the vertical fixed rail fall arrest runner.

Rescue equipment for evacuation purposes generally purely consists of abseiling equipment without any lifting function. Typical rescue equipment is designed for a maximum load of two people and normally for abseiling heights of up to 400 meters (m). For anchoring purposes, the rescue equipment is fitted with a length-adjustable connector, and depending on the operative use, also a ladder fixing for the vertical fixed rail fall arrest ladder.

Like other fall arrest PPE, rescue equipment must also be inspected once a year by a competent person. In addition to that if the rescue equipment is used for training or instruction purposes, additional safeguarding must be ensured; and after each use for those purposes the rescue equipment must be inspected by a competent person.

3.6.8.3. Evacuation

Evacuation by means of rescue equipment is necessary when the normal access and exit routes are no longer safe to use in wind farm installations. Possible cause for evacuation could be fire or smoke

[120] http://shop.bsigroup.com/ProductDetail/?pid=000000000030193347

formation in the tower section or electrocution at heights. This section focuses on evacuation from WTGs with using different exit routes.

Evacuations from WTGs via nacelle floor hatch route require the following process:

a. Identify the risks.
b. Make the emergency call.
c. If appropriate, launch fire-fighting measures while simultaneously ensuring one's own safety and possibility of escape.
d. Fix the rescue equipment to the appropriate anchorage point over the floor opening.
e. In the case of grave danger, both inspectors/technicians must abseil together.
f. Attach the carabiner at the end of the rope of the rescue equipment to the front ring of the fall arrest harness, and inspect it before use.
g. Attach the rope bag to the lateral holder rings of the fall arrest harness.
h. Open the floor hatch.
i. Exit and abseil.
j. Upon reaching the ground, detach from the rescue equipment and leave the vicinity of the WTG immediately.

Evacuations from WTGs via nacelle roof hatch route require the following process:

a. Identify the risks.
b. Make the emergency call.
c. If appropriate, launch fire-fighting measures while simultaneously ensuring one's own safety and possibility of escape.
d. Fix the rescue equipment to the appropriate anchorage point over the floor opening.
e. In the case of grave danger, both inspectors/technicians must abseil together.
f. Attach the carabiner at the end of the rope of the rescue equipment to the front ring of the fall arrest harness, and inspect it before use.
g. Attach the rope bag to the lateral holder rings of the fall arrest harness.
h. Open the floor hatch.
i. Exit and abseil.

Upon reaching the ground, detach from the rescue equipment and leave the vicinity of the WTG immediately. Evacuations from WTGs via nacelle roof access route require the following process:

a. Identify the risks.
b. Make the emergency call.
c. If appropriate, launch fire-fighting measures while simultaneously ensuring one's own safety and possibility of escape.
d. Fix the rescue equipment to the appropriate anchorage point over the floor opening.
e. In the case of grave danger, both inspectors/technicians must abseil together.

f. Attach the carabiner at the end of the rope of the rescue equipment to the front ring of the fall arrest harness, and inspect it before use.
g. Attach the rope bag to the lateral holder rings of the fall arrest harness.
h. Open the floor hatch.
i. Exit and abseil.
j. Upon reaching the ground, detach from the rescue equipment and leave the vicinity of the WTG immediately.

3.6.8.4. Rescuing a Person from a Vertical Fixed Rail Fall Arrest System

The standard rescue process involving a rescuer reaching the injured person by climbing up the ladder on a vertical fixed rail fall arrest system, which comprises vertical ladder installation on the tower wall, comprises the following steps:

a. Identify the emergency.
b. Speak to the injured person, if possible, and explain the situation.
c. Make the emergency call.
d. Fetch rescue equipment and attach to the harness.
e. Rope bag remains below.
f. Climb up to the injured person.
g. Remove the offending connector from the person to be rescued.
h. Carefully push the person to be rescued to the right side.
i. Continue to climb up until under the vertical fixed rail runner of the person to be rescued.
j. As the rescuer attach yourself using your connector.
k. Secure rescue equipment to ladder mounting.
l. Secure rescue equipment with retaining rope.
m. Pull out the rope end from the rescue equipment and carabiner in the front sternal ring of the fall arrest harness of the person to be rescued.
n. Pull and tighten the rope between the person and the rescue equipment.
o. Insert the descent rope end into the diverter and block in jam cleat.
p. Open the handle on the hand-wheel.
q. Lift the person by turning the hand-wheel.
r. Pull and tighten the rope in the jam cleat.
s. Lift the person until the vertical fixed rail runner is released.
t. Disconnect vertical fixed rail runner.
u. Rope down the injured person, while guiding the rope by hand.
v. Guide the descent rope and carabiner over the right-hand holding ring as soon as possible.
w. As soon as the feet of the injured person touch the ground, stop the roping down process.
x. As rescuer release yourself and climb down.
y. Keep the descent rope tensioned with one hand while climbing down.

z. As the rescuer, position the person on the ground depending on their condition as soon as you reach the ground/platform and if necessary implement first aid on the injured person.

The standard rescue process involving a rescuer reaching the injured person by climbing down the ladder on a vertical fixed rail fall arrest system, which comprises vertical ladder installation on the tower wall, is more complicated as the rescuer coming from above must pass the injured person first on the way to fetch the rescue equipment before climbing back up to carry out the rescue. This process comprises the following steps:

a. Identify the emergency.
b. Speak to the person, if possible, and explain the situation.
c. Make the emergency call.
d. As rescuer, descend to the injured person.
e. As rescuer, take the end of the connector (pipe hook) of the injured person and attach it as high as possible at a suitable point on the vertical fixed rail.
f. As rescuer secure yourself by clipping your connector to the vertical fixed rail and release your vertical fixed rail runner.
g. As rescuer, climb down until you can push up the injured person with your shoulders (shoulder rescue).
h. As rescuer, release the injured person from your vertical fixed rail runner and lower the injured until the latter hangs from your connector.
i. As rescuer, clip yourself into the lower vertical fixed rail runner and climb down.
j. As rescuer, climb up again after fetching the rescue equipment.
k. As rescuer, climb so far past the injured person so that you can secure the rescue equipment above on the vertical fixed rail ladder.
l. As rescuer, secure yourself with your connector.
m. As rescuer, attach the injured person to the rope end of the rescue equipment (if available by the front ring).
n. As rescuer, insert the rope of the rescue equipment in the diverter and block it in the jam cleat.
o. As rescuer, open the handle on the hand-wheel and lift the injured person so far that you can release the connector.
p. Rope down the person, while guiding the rope by hand.
q. Guide the descent rope and carabiner over the right-hand holding ring as soon as possible.
r. As soon as the feet of the injured person touch the ground, stop the roping down process.
s. As rescuer, release yourself and climb down.
t. Keep the descent rope tensioned with one hand while climbing down.

u. As the rescuer, position the person on the ground depending on their condition as soon as you reach the ground/platform and if necessary implement first aid on the injured person.

3.6.8.5. Rescue a Person from the Fall Arrest PPE

Rescuing a person, who has fallen from a platform of nacelle hub or roof in their fall arrest PPE, requires very great deal of care. Such rescue should follow the steps outlined below:

a. Identify the emergency.
b. Speak to the person, if possible, and explain the situation.
c. Make the emergency call.
d. Inform the person about the rescue procedures.
e. Fetch the rescue equipment.
f. As rescuer, secure yourself with your connector.
g. Anchor the rescue equipment to a suitable anchoring point.
h. Apply edge protection next to the connector of the person to be rescued (if necessary).
i. Pull out the rope end with rope cleat of the rescue equipment to the length required.
j. Attach the rope cleat at the rope end of the rescue equipment to the connector of the injured person (below the edge).
k. Insert the brake cable on the rescue equipment into the diverter and block it into the jam cleat.
l. Lift the injured person so far by turning the hand-wheel until the connector can be released from the anchoring point.
m. Clip the carabiner of the connector to the carabiner of the rope cleat.
n. Lower the person down.
o. As rescuer, ensure that the rope can be released freely from the rope bag of the rescue equipment.
p. If no other rescuer is available, as the sole rescuer immediately descend after starting the lowering process.
q. As the rescuer, position the person on the ground depending on their condition as soon as you reach the ground/platform and if necessary implement first aid on the injured person.

3.6.9. Risk Assessment

This document addresses all major safety risks which are inherent in OWF and ONWF (including offshore, onshore substations and transmission cables) operations and stresses the importance of risk management process to ensure safe operations for people and environment. As mentioned earlier, a proper safety risk management process requires risk to be identified, assessed and handled by avoiding, mitigating or eliminating the risks. Within this framework, all safety risks need to be identified and assessed by using a risk register or risk matrix.

Table 31 provides a sample risk matrix.

Risk Matrix						
Probability (P)		Risk Factor (RF)				
Very high	5	5	10	15	20	25
High	4	4	8	12	16	20
Medium	3	3	6	9	12	15
Low	2	2	4	6	8	10
Minimal	1	1	2	3	4	5
		1	2	3	4	5
		Insignificant	Low critical	Critical	Very Critical	Catastrophic
		Insignificant Damage	Minor Damage	Significant Damage	Serious Damage	The Most Serious Damage/Death
		Effect (E)				

Risk factor	Risk	Safety Measures	Need for Action/Checking
	High	Only with effective safety measures	Immediate need for action/Permanent checking
	Medium	Only with appropriate safety measures	High need for action/Checking
	Low	Safety measures recommended	Low need for action

Table 31 – Sample Risk Matrix

3.6.10. Risk Identification for Wind Farm Installation Inspections at Onshore and Offshore Locations

As emphasized in this document earlier, on the basis of national, European or international health and safety at work regulations, companies are legally bound to identify the risks associated with any workplace, to assess the risk, to specify safety measures and to verify the effectiveness of the safety measures, which are taken to handle the risks. This rule applies to all workplaces, i.e. not only on the company premises, but also at temporary workplaces, such as construction sites, permanent or temporary storage places etc.

In accordance with the relevant national and international regulations, such as, for example, EU directive 89/391/EC, companies are required to perform documented risk identification for all workplaces. As far as the use of equipment is concerned, the EU directive 2001/45/EC provides for compulsory risk identification based on the field of application.

This risk identification has been drawn up based on the most up-to-date knowledge and relevant regulations, and further amendments and extensions will be necessary to respond to the most up-to-date findings and changing hazards. This risk identification should be viewed in the light of the emergency and rescue procedures in connection with the rescue and emergency program for wind farm installations.

Using this general risk identification as the basis, significant hazards may, however, require specific work-related hazard assessment in order to ensure safety. In this particular risk identification process it is important to assess the variable parameters, such as wind speed, wave height for offshore deployments and inspections, and currents for subsea cable inspections, for example, and to stipulate effective safety measures. When carrying out a risk identification process it is important to comply with the applicable regulations in order to define requisite protection measures. For example, in Europe relevant directives and regulations such as EU-Directive 89/391/EC, EU-Directive 2001/45/EC, German Legislation Regulation A 1 “Basic Health & Safety Principles”, German Legislation Regulation 198 “Fall Arrest PPE” or “UK Health and Safety at Work etc. Act 1974” will be taken into account when carrying out a risk identification process.

3.6.11. Basic Rules for Safety

Working on OWF and ONWF installations including offshore and onshore substations, Met-Mast and inspecting transmission cables offshore and onshore present a number of safety hazards for people and environment. Therefore it is vital to make sure the basic safety rules, which are listed below (it is referred to the wind farm which consist of WTG, OSP, onshore substation, Met-Mast and transmission cables for offshore installations), are adhered to:

a. Wind farm are installed and commissioned by specialist personnel, in accordance with the manufacturer’s instructions.
b. The operation of the wind farm is only performed by suitably trained and authorised specialist personnel.
c. Maintenance and inspections works at a wind farm are only carried out by trained specialist personnel whose work is compliant with applicable safety regulations and the operations and maintenance instructions of wind farm component manufacturers.
d. Work on electrical equipment must only be performed by qualified electricians or trained inspectors in conjunction with qualified electricians.

e. Safety devices must only be dismantled or removed in exceptional cases, and if unavoidable, and then it should only be done so at the time of maintenance or other necessary works. All special safety measures must be taken to avoid any risk.
f. Only trained specialist personnel must have authorised access to the wind farm. If an inspector does not have the relevant training, s/he must only be permitted to a wind farm site under the supervision of trained specialist personnel.
g. When transferring to an OWF or entering to an ONWF, all safety-relevant tasks must be complied with.
h. All persons who work at a wind farm site must use the necessary PPE as intended.
i. All necessary emergency and rescue measures must be put in place during any visit to a wind farm.
j. Access to a nacelle for inspections is strictly forbidden when WTG is in operation.
k. Access to nacelle for fault detection purposes or taking readings may be permitted when WTG is in operation, provided that specific risk identification is carried out and special safety care is taken in advance.
l. The necessary safety equipment (rescue equipment/fire extinguisher/first aid equipment) must always be ready for use in the wind farm.
m. All relevant standards, rules and regulations must be complied with (such as German legislation BGV A1/BGR 198/BGR 199, BGI 657).
n. The protection and safety equipment must be inspected during regular maintenance visits to ensure that they are fit for purpose.
o. All persons who are required to work at wind farms must hold the necessary qualifications with regard to safety-relevant issues, emergency response and rescue procedures.
p. All applicable safety signs on and in wind farm components must be displayed.
q. Appropriate operating instructions must be available in the WTG or substations.
r. Maintenance technicians and inspectors must be trained in the use of the WTG access system.
s. Only suitably qualified workers are authorised to operate the cargo crane and access the transformer room.
t. The size of the inspection team or maintenance team will depend on the potential hazard. Offshore work requires at least three qualified workers.
u. The inspectors/technicians must be medically approved.
v. The inspectors/technicians must be physically strong, fit and in good physical condition.
w. The inspectors/technicians must be professionally qualified but also suitably qualified in the technical safety aspects for the scheduled work.
x. The inspection and maintenance works must be performed under the leadership and supervision of a qualified and experienced supervisor.
y. The inspectors/technicians must attend a refresher course once a year to update their safety-relevant knowledge, upon which they are also examined.
z. Regular training in emergency and rescue procedures must take place and the trainings must be relevant to the field of application.

aa. The complete safety-relevant equipment must be fully functional and safe to use and must be checked once a year by a specialist/qualified person.
bb. Every work assignment must go through the task-specific risk identification and risk assessment exercise led by the supervisor in charge.
cc. Emergency and rescue procedures are put in place specifically for each inspection or maintenance task.
dd. Each inspection or maintenance task must be performed in such a way that it is immediately possible to recognise an emergency situation in order to implement rescue measures promptly.
ee. The supervisors in charge must specify safe and sufficiently load-bearing anchorage points for all the safety systems.
ff. The on-site supervisor in charge is responsible for taking any safety-relevant decisions into account with regards to actual execution of the work or inspection.

3.6.12. Operating Instructions use of Rope Access Technique

Information on operating instruction for the use of Rope Access Technique (RAT) is provided in Appendix A.

3.6.13. Operating Instructions for the Use of FA, PPE, Fall Prevention Equipment

Information on operating instruction for the use of Fall Arrest, PPE and Fall Prevention System is provided in Appendix B.

3.6.14. Operating Instructions rescue from Fall Arrest System

Information on operating instruction for the rescue from Fall Arrest, PPE and Fall Prevention System is provided in Appendix C.

3.6.15. Operating Instructions Evacuation

Information on evacuation from WTGs using PPE is provided in Appendix D.

3.6.16. Risk Identification for Inspections

Information on risk identification for WTG inspections is provided in Appendix E.

3.6.17. Scheduling Work on Offshore Wind Turbine Farms

Prior to arranging transport to the Offshore WTG, OSP or Met-Mast, manager in charge must first perform task-specific risk identification and risk assessment and prepare risk assessment method statements, covering the different aspects of the task-risks such as:

a. Weather conditions (current/forecast for the duration of the work)
b. Means of transport (Helicopter/Boat)
c. The offshore chain of rescue procedures must be in place (chain of survival)
d. Training status and size of team
e. Specific risk due to the nature of the scheduled work
f. Scheduled duration of the work

On the basis of the task-specific RAMS, a decision will subsequently be taken on the feasibility of the scheduled offshore work. If the decision is in favour of carrying out the assignment, the content RAMS must be communicated to team members who are assigned to carry out the tasks.

It is very important to remember that the OWF components must only be accessed when the following points have been adequately addressed:

a. Safe transport to and from the WTI is ensured.
b. The chain of rescue procedures for all possible emergencies is in place.
c. Training status and team size meet the safety-relevant regulations.
d. The result of the risk identification and risk assessments is positive as such that the inspection and maintenance works can be performed safely.

3.7. Major Safety, Health and Environment (SHE) Risks

This section addresses what possible accidents or incidents pose the greatest risk to human and environmental safety.

3.7.1. Fall from Transfer Vessel

One of the safety risks for OWF installation and maintenance activities is falling into sea/ocean during transfer from a transfer vessel to the Offshore WTG platform or OSP platform. In the UK, Construction (Health, Safety and Welfare) Regulations 1996 make demands to prevent drowning. The clause 14[121] states that:

(1) Where during the course of construction work any person is liable to fall into water or other liquid with a risk of drowning, suitable and sufficient steps shall be taken:

a. to prevent, so far as is reasonably practicable, such person from so falling; and

b. to minimize the risk of drowning in the event of such a fall; and

c. to ensure that suitable rescue equipment is provided, maintained and, when necessary, used so that such person may be promptly rescued in the event of such a fall.

*(2) Suitable and sufficient steps shall be taken to ensure the safe **transport** of any person conveyed by water to or from any place of work.*

(3) Any vessel used to convey any person by water to or from a place of work:

a. shall be of suitable construction; and

b. shall be properly maintained; and

c. shall be under the control of a competent person; and

d. shall not be overcrowded or overloaded.

[121] The Construction (Health, Safety and Welfare) Regulations 1996, UK
http://www.legislation.gov.uk/uksi/1996/1592/regulation/14/made

3.7.2. Vessel Collision

Vessel collision is another offshore activity, which presents to safety to people on board and to the environment. Even though the vessel collision frequency is relatively low, because the consequences of collisions may be significant in terms of injuries, fatalities and oil spill, the adequate risk assessments must be carried out in order to implement effective risk handling practices to eliminate or minimize collision risks, collision damage and potential environmental impact. The vessel collusion risk can be reduced by carrying out risk handling practices such as proper marking of the offshore wind turbines to improve visibility or installing radar based ship detection in combination with emergency towing capabilities. It is also recommended use classical fendering techniques and damage reduction design optimization in order to reduce a vessel collusion risk. Prevention of a vessel collusion risk also eliminates the environmental impact of collusion by avoiding oil spill from vessel.

3.7.3. Aircraft / Helicopter Collision

Although commercial air traffic does not appear to be a major safety issue with regards to OWFs, the same cannot be said for small aircraft or helicopter flights. Although the probability of such collision is very low, the risk is present for helicopters and small aircrafts flying over OWFs particularly in bad weather conditions. The risk is particularly prominent for the rescue helicopters, which may be used to access an offshore wind turbine or OSP in bad weather conditions. Particularly the heavy turbulence caused by wind turbines hampers helicopter maneuvers within an OWF area making rescue operation considerably more complex than that of used for the offshore oil and gas platforms. Therefore the access to OWFs via helicopters requires detailed risk assessments in advance. Also the use of navigation lights and radar in an OWF will mitigate the risk of aviation collision.

The Draft Environmental Statement on Aviation and Radar for Kentish Flats OWF Extension Project issued by Vattenfall Continental/UK Renewables Ltd[122] provides useful information on potential impact of an OWF on aviation radar associated with national air traffic, local airports, helicopter operations and national defense. This document provides a good example on how to carry an OWF risk impact on aviation traffic and national defense as it addresses guidance and consultation process, impact assessment methodology, status quo, potential impacts during construction / operations / decommissioning and cumulative impacts.

3.7.4. Fire in WTGs

Fire in wind turbines is one the main safety hazards not only for people but also for the environment.

Fires inside wind turbines are most likely to start from the main transformer and high voltage equipment, the main power cables, lightning strikes, or ignition of flammable materials in the nacelle by drivetrain overheating. The main transformer is often installed inside the base of the tower, and the main power cables installed the length of the tower provide a path for fires starting in the tower base to

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[122] Kentish Flats Offshore Wind Farm Extension Draft Environmental Statement Section 17: Aviation and Radar, Vattenfall Continental / UK Renewables Ltd, http://www.vattenfall.co.uk/en/file/110321_Section_17_Aviation_and_Radar__V3.0.pdf_17878789.pdf

quickly spread upwards into the nacelle. The nacelle cover, blades, cable insulation, grease and oils are flammable and many components in the wind turbine release toxic gases when burned.

In the UK, the Fire Precautions (Workplace) Regulations 1997, PART II, Regulation 6[123] calls for maintenance practices:

"(6) Maintenances: Where necessary in order to safeguard the safety of employees in case of fire, the workplace and any equipment and devices provided in respect of the workplace under regulations 4 and 5 shall be subject to a suitable system of maintenance and be maintained in an efficient state, in efficient working order and in good repair.

UK Environmental Protection Act 1990 prohibits emissions from any premises (including wind turbines) that are prejudicial to health or cause a statutory nuisance, one that interferes with a person's reasonable use of their own premises, including chemical contamination, smoke; fumes or gases; dust; steam; smells or other effluvia and noise.

In the US, OSHA Regulations (CFR 30 Part 1910 subpart E) require a Fire Prevention Plan to be used to reduce personnel exposure to fire risk. This includes design solutions and procedures.

Fire protection in offshore wind turbines varies between wind turbine suppliers and operators. All on- and off-shore wind turbines are equipped with manual fire extinguishers which are limited to stopping small fires before they spread, or aiding escape. Most offshore wind turbines are equipped with some level of automated fire detection, suppression, and alarm. The automatic suppression is limited and typically does not cover the whole inside of the wind turbine, often only installed inside electrical cabinets.

Evacuation procedures for fires are developed by the wind turbine designer or the operator, and should be included in the Operation and Maintenance instructions. If the worker is above the fire, the only evacuation route is via a manual or automatic rope descent device from an escape point at the rear of the nacelle, which will land the escaping person on the platform or possibly in the ocean. PPE, clothing, and evacuation equipment is typically not required to be fire rated, and breathing equipment (SCBA) is typically not included in the emergency equipment.

Fires originating below a worker in the tower present special risks. Because of the configuration of the tower and placement of the electrical equipment and cables, smoke can fill the inside of the tower, overcoming people trying to evacuate by climbing up to the nacelle. ABS has found no standard or recommended practice for evacuation from a wind turbine tower during fire. This is an area requiring further development industry-wide.

[123] The Fire Precautions (Workplace) Regulations 1997, Part II, Regulation 6, http://www.legislation.gov.uk/uksi/1997/1840/regulation/6/made

3.7.5. Electrical Shock, Electrocution, and Arc Flash

Exposure to live parts during service of the wind turbine is a significant health and safety risk. Designers, operators and regulators have made improvements in this area in recent years, however inconsistent regulations in global markets can create confusion for designers and operators, leading to poorly implemented protection systems and procedures. An increased focus on electrical safety procedures and training similar to that for fall protection would benefit the industry.

Electrical installations include low voltage auxiliary power distribution, main power, typically 690 to 900V, and high voltage up to 35kV for transmission to the substation. The majority of this equipment is located inside the wind turbine tower or nacelle, or inside the transition piece of the substructure.

3.7.5.1. Electrical Shock and Electrocution

Protection against electrical shock for US installations is covered by OSHA regulations (CFR 29 part 1910) as well as the *National Electric Code* (NFPA 70) and the *National Electric Safety Code* (IEEE C2/ ANSI C2).

As these standards and regulations overlap, and not all parts of each standard are applicable for a power generation facility, designers are often confused about how to achieve compliance.

Protective measures include

a. Lock-out Tag-out (LOTO) procedures for working on electrical equipment

b. Guards for live parts

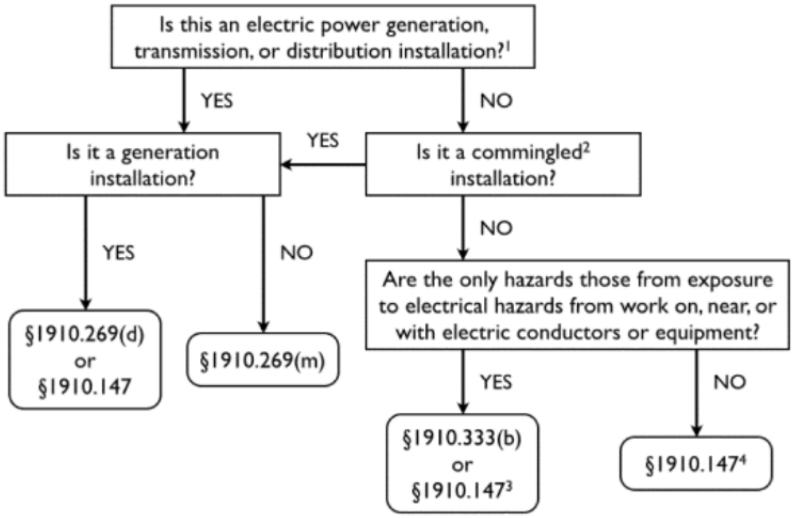
c. Clear area requirements about electrical parts

d. Safe approach distances

e. Grounding and earthing techniques

f. Warning labels outside electrical cabinets

The applicable US regulations for LOTO are determined according to the flowchart depicted in Figure 28 from Appendix A1 to 29 CFR Part 1910 Subpart R section 269.



[1]If a generation, transmission, or distribution installation conforms to §§1910.302 through 1910.308, the lockout and tagging procedures of §1910.333(b) may be followed for electric-shock hazards.

[2]This means commingled to the extent that the electric power generation, transmission, or distribution installation poses the greater hazard.

[3]Paragraphs (b)(2)(iii)(D) and (b)(2)(iv)(B) of §1910.333 still apply.

[4]Paragraph (b) of §1910.333 applies to any electrical hazards from work on, near,, or with electric conductors and equipment.

Figure 28 Applicable regulation for confined spaces from 29 CFR 1910.269 Appendix A

An example Lock-out/ Tag-out procedure is given in NFPA 70E Chapter 3, Annex G.

3.7.5.2. Arc Flash

Arc flash risk is different than electric shock, and can cause serious injury to personnel working in or near the enclosure where the fault occurs, including burns, inhalation injury, exposure to toxic gas, injuries from rapid pressure increase and flying shrapnel, and hearing damage.

For US installations, a specific arc flash hazard analysis for power generation and transmission equipment is required by US national standard (ANSI/ IEEE C2, *National Electric Safety Code*) and by US law (OSHA Regulations, CFR 29 Part 1910 Subpart R Section 269 (l)(8) and Appendix E). Methods for performing the arc flash hazard analysis are described in *Standard for Electrical Safety in the Workplace* (NFPA 70E) and *Guide for Performing Arc-Flash Hazard Calculations* (IEEE 1584). Either method may be used to fulfil the requirement.

The hazard analysis includes estimation of the probability of an event, and an estimation of the energy which personnel would be exposed to, and must be performed for each electrical installation in the wind turbine.

The results of the analysis must then be used to determine appropriate levels of fire resistant (FR) clothing and PPE required for different tasks. The hazard must also be posted where exposure can occur, clearly stating the level of exposure, allowed approach distances, and level of PPE required (see Figure 29).

There are currently no similar regulations in Europe, which makes this an area requiring scrutiny for compliance with US regulations in offshore wind turbines imported from Europe.

Protective measures include

a. Warning labels
b. PPE including fire resistant clothing, face, eye, and hand protection
c. Minimum approach distances

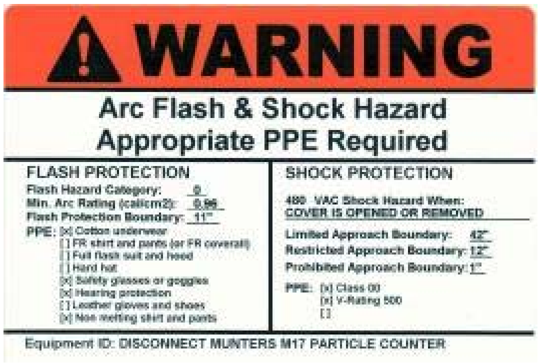


Figure 29 – Example Arc Flash Warning Label

Engineering controls and work processes to reduce exposure should be considered. For example the severity of the consequence of an electric arc may be reduced by including arc detection sensors and an arc-quenching circuit breaker. Proper training on the hazards of arc flash and selection of PPE is also required for workers in and on the offshore wind turbine.

3.8.Inspection Tools and PPE

This section addresses what inspection tools and PPE inspectors must have when inspecting offshore wind turbines.

Any PPE, tool or equipment, which may be used for inspections should be chosen which satisfies legal requirements in the country of use. These requirements vary from country to country and sometimes from region to region. PPE, tool and quipment that conform to an appropriate standard is important, but is not the sole factor in the selection criteria. Sometimes, a standard might not cover all the requirements advisable for their use. In some cases PPE, tool or equipment that conforms to a combination of requirements from more than one standard e.g. a hybrid of two standards, might be more appropriate; the manufacturer of PPE/tool/equipment or their authorized representative should be able to provide information.

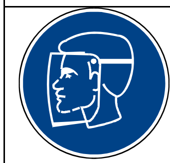
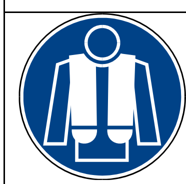
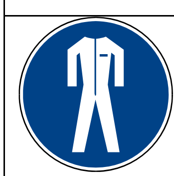
Depending on the activities, a number of PPEs will need to be used when working the onshore facilities of an OWF or at the actual offshore site. Table 32 below provides a PPE matrix, which needs to be completed by a competent person based on relevant onshore and offshore site inspection requirements.

Area	Eye/Face Protection	Respiratory Equipment	Hand Protection	Protective Clothing	Safety Footwear	Head Protection	Fall Arrest /Climbing Equipment	Immersion Suit	Life Jacket	Noise Protection
On transfer Vessel										
Working on Vessel Deck										
When in front of Bow Handrail										
Transiting from Vessel to Boat Landings on TP and OSP.										
Inside Tower Sections										
Inside WTG Nacelle										
Inside WTG Rotor Blade (internal inspections)										
WTG Rotor Blade (external inspections)										
Under Airthight Platform of MP Foundation										
Subsea										
Heli-Hoist Area										
Helicopter Transit Passenger										
On OSP Deck										
In Offshore / Onshore Substation										

Table 32 - PPE Matrix

3.8.1. Safety Equipment

Due to the multitude of hazards associated with wind farms and ancillary installations such as OSPs, meteorological measurement facilities, transmission cables, accommodation units, the use of appropriate PPE is paramount. Therefore after completion of a risk assessment, inspection task based, fully functional and appropriate PPE must be selected. PPE must only be used in correct and appropriate manner in accordance with the manufacturer’s safety instructions. Table 33 below show general PPE used in OWF inspections in accordance with hazards and inspection works:

Sign	Description
	Hearing Protection Protection against harmful noise risk
	Face Protection Protection against particle etc. hitting face and eyes
	Respiratory Protection Protection against dust and toxic fumes inhalation risk
	Survival Suit Protective clothing against hypothermia risk in water, required when offshore transfer/work. Designed as an Immersion Suit or Anti-Exposure Suit, depending on the water temperature.
	Life jacket Protection against drowning risk when accessing to and work on OWF and ancillary installations (buoyancy up to 275 N)
	Protective Helmet for Working at Heights Protection against risk of hitting hard objects. Special safety helmet for workers at heights with suitable straps to ensure that the helmet fits securely onto the head.
	Protective Work Clothing Protection against environmental hazards. Clothing appropriate to the hazard and weather conditions.

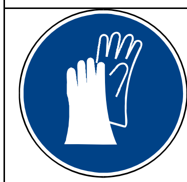
Sign	Description
	Safety shoes Protection of feet against. Safety shoes with protective cap and impenetrable soles, anti-slip soles for climbing, ankle height to prevent injury.
	Protective Gloves Protection of hands. Appropriate to the hazard and the scheduled work; sufficiently robust to abseil.
	Goggles Protection of eyes when face protection mask is not used. Appropriate to the hazard and scheduled work.
	Fall Arrest PPE Protection against fall from heights.

Table 33 – PPE for OWF Inspections

PPEs that inspectors must have when inspecting offshore WTG should include the following:

a. Gloves to protect against cold weather, injury or other harmful effects.
b. Eye or face protection, which is usually also required if chemicals are being sprayed for example when carrying out dye penetrant inspections (DPI), which could cause irritation or injury to the eyes..
c. Respiratory protective equipment, where there is a risk of inhalation of harmful chemicals or dust such as in the rotor blade or under the airtight deck within MP foundation.
d. Hearing protectors, when noise levels could cause a risk of hearing loss to rope access technicians.
e. Helmets to prevent head injuries. Helmets should be light weight, but without compromising safety, must have good fit, i.e. adjustable to the wearer’s head size, must have the ability to mount ancillary equipment such as communications equipment; headlamp; ear protectors, visors. Helmets should not restrict vision (downwards, sideways and upwards) and provide good ventilation, particularly for inspections in hot climates.
f. Buoyancy or life jackets, when working over water. These should be of a type capable of being secured to the wearer so that they cannot accidentally come loose in the event of a fall. In

addition, they should not obstruct the wearer or prevent the efficient operation of the anchor line devices when used.

g. Protection against sunburn, e.g. by the use of a sunscreen.

Any variation in normal procedures in the use of PPE in an OWF site (e.g. lifejackets; eye protection; safety footwear; helmet), for whatever reason, should first be cleared with the site SHE representative [124].

3.8.2. Fall Arrest PPE

As mentioned earlier, one of the highest safety risks is the risk of falling when climbing up and down a WTG, OSP or Met-Mast or working at heights in those installations. Therefore, it is compulsory to use appropriate fall arrest PPE in accordance with safety instructions when carrying out inspections or working at heights in wind farm installations. There is also a requirement to use fall arrest PPE when taking part in evacuation and rescue operations involving bringing down an injured person from a WTG, OSP or Met-Mast.

It is important to ensure that the fall arrest PPE is fit for purpose and ready for use at all times to be able to attend evacuation and rescue operation in case of an emergency in a WTG, OSP or on Met-Mast.

Because fall arrest PPE is Category III PPE[125] as it is used against mortal danger, it is compulsory to meet the following requirements in EU member states:

a. Fall arrest PPE must be design tested.
b. Fall arrest PPE must only be used as intended and in accordance with the manufacturer's instructions.
c. Only use fall arrest PPE which is in safety compliant condition.
d. Fall arrest PPE must be checked by the user prior to use.
e. Any fall arrest PPE which is no longer safe to use must immediately be removed from service.
f. Fall arrest PPE must be inspected at regular intervals (every 6 months) by a competent person.

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[124] IRATA International Code of Practice for Industrial Rope Access, page 39, IRATA International, http://www.google.co.uk/url?url=http://irata.associationhouse.org.uk/show_doc.php%3Fdoc_id%3D3684&rct=j&frm=1&q=&esrc=s&sa=U&ei=Vtj2VOq6HtbvaPKtgZgD&ved=0CBsQFjAA&usg=AFQjCNG8WJRiIavWstNNSq8wSVJPz73JXA

[125] Article 1 of Directive 89/686/EEC defines PPE as any device or appliance designed to be worn or held by an individual for protection against one or more health and safety hazards. PPE which falls under the scope of the Directive is divided into three categories:

• Category I: Simple design (e.g. gloves, footwear, goggles)

• Category II: PPE not falling into category I or III (e.g. personal flotation devices, dry and wet suits)

• Category III: Complex design (e.g. respiratory equipment, harnesses, fall arrest system)

g. On safety grounds, a fall arrest PPE set must be issued to an individual user personal user.

The following Figure 30 shows the minimum fall arrest PPE set requirements for carrying out inspections at height in WTGs, OSPs or Met-Masts.

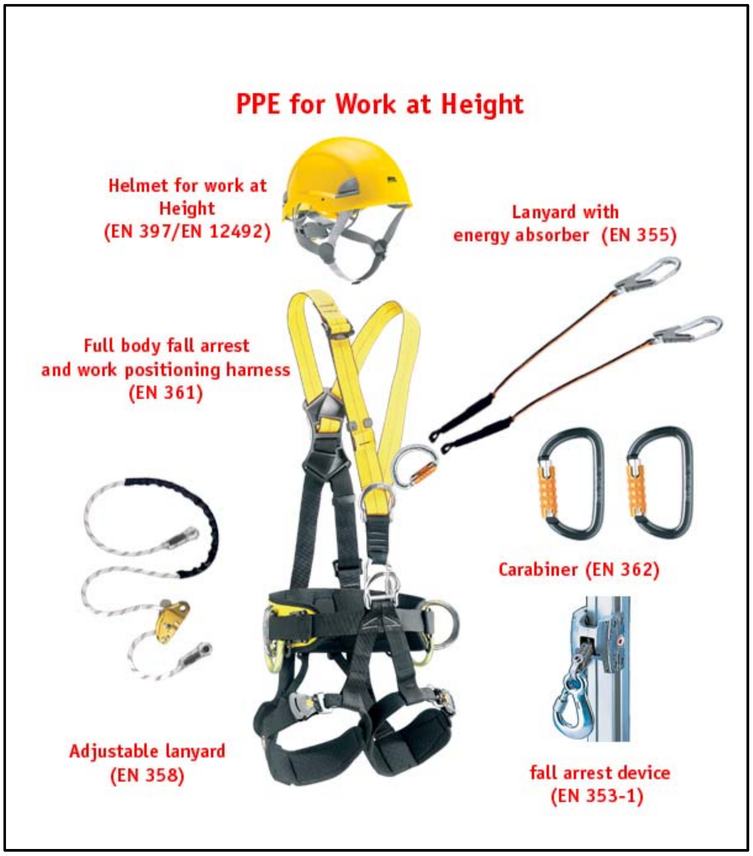


Figure 30 – Minimum Fall Arrest PPE Set

Selection and use of tool and equipment is important for the safe inspections when working at heights. Guidance on the selection and use of equipment is provided in the IRATA International Code of Practice for Industrial Rope Access Part 2, 2.7. An application specific assessment must be carried out before each inspection at heights to select the most appropriate equipment to be used. Where the suitability of a piece of equipment is unknown, it should be thoroughly evaluated and/or tested before it is used. Rope access equipment should be selected only for its intended purpose as specified by the manufacturer. If equipment is to be used for other applications, confirmation should be obtained from the manufacturer that it is acceptable to do so and any caveats should be taken into account. The assessment should also pay special attention to the probability and consequences of misuse of equipment, taking into account any known incidents, e.g. as detailed in IRATA International safety bulletins. The selection and purchase of equipment should be carried out by, or approved by, a competent person, who has sufficient knowledge of the technical specifications required[126].

According the IRATA, even if it is decided to use other equipment to assist the rope access operation, e.g. guided type fall arresters, retractable fall arresters, positioning suckers, powered climb-assist equipment the attention must be drawn for the need to:

a. assess the appropriateness of the equipment selected for the given task, i.e. carry out a risk assessment on its suitability,
b. train the rope access technicians in the correct use of the equipment,
c. be aware of any limitations in the equipment's use,
d. know how to inspect equipment and when to retire it.

In all cases, harnesses must be equipped with appropriate fall arrest and work positioning attachment points and they should be checked to ensure they are compatible with on-site fall arrest systems when selecting tools and equipment for inspections at heights. Compatibility with other personal protective equipment e.g. immersion suits, buoyancy aids and lifejackets must be established.

All requisite arrest PPE set is listed in Table 34 below.

Illustration	Description	Quantity	European Standard
	Safety Helmet for Working at Heights With suitable strap to secure the helmet onto the head.	1	EN 397 EN 12492
	Fall Arrest Harness With sternal and dorsal fixing points; integrated sit harness recommended.	1	EN 361 EN 358 EN 813

[126] IRATA International Code of Practice for Industrial Rope Access, page 21, IRATA International, http://www.google.co.uk/url?url=http://irata.associationhouse.org.uk/show_doc.php%3Fdoc_id%3D3684&rct=j&frm=1&q=&esrc=s&sa=U&ei=Vtj2VOq6HtbvaPKtgZgD&ved=0CBsQFjAA&usg=AFQjCNG8WJRiIavWstNNSq8wSVJPz73JXA

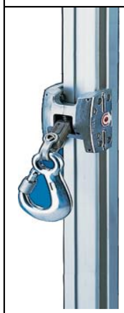
Illustration	Description	Quantity	European Standard
	Connector with Fall Energy Absorption Y- Fall energy absorber with safety hook, to ensure constant safety in fall risk areas.	1	EN 355
	Connector, Carabiner Carabiner with locking mechanism, automatic locking and redundant safety recommended.	4	EN 362 EN 12275
	Lanyard With rope shortener, used for positioning and restraining purposes.	1	EN 358
	Vertical Fixed Rail Fall Arrest Runner Matching the vertical fixed rail fall arrest system installed in the wind turbines.	1	EN 353-1

Table 34 – Fall Arrest PPE Set

IRATA provides guidance on equipment for work restraint, work positioning and fall arrest. For the work restraint (travel restriction) equipment, if the objective is to restrict the user's travel so that access is not possible to zones where the risk of a fall from a height exists, work restraint equipment may be used. This could be fall arrest equipment, work positioning equipment, or even a simple belt and lanyard of limited length and strength. Different countries or states may have their own regulations with regard to what is acceptable. To ensure theuser is working in restraint, there should be no fall hazards within reach of the user. For the work positioning equipment, if the planned method of work is for the user to be in a partly or entirely supported position, as is the normal case for rope access work, then work positioning equipment may be chosen. In addition to its primary function of providing support, this equipment is designed to be strong enough to arrest a free fall of limited distance and force but will not meet the other essential requirements of a fall arrest system, unless combined with appropriate components. Work positioning harnesses for rope access work may be a sit harness or full body harness, dependent upon the precise nature of the work to be carried out. In work positioning, there should be minimal slack in the system, e.g. dynamic rope anchor lanyards used in horizontal aid climbing or with a horizontal traverse line should be attached above the rope access technician's harness attachment point in such a way as to ensure little or no slack, therefore minimizing the consequences of a fall from height. For the fall arrest equipment, if the planned method of work is such that should the user lose controlled physical contact with the working surface (such as rotor balde) there would be a significant free fall (outside the normal bounds of rope access, it is necessary to choose fall arrest equipment. This includes an appropriate full body harness and a system that limits the impact load to an acceptable level. This level varies internationally between 4 kN and 8 kN. Maximum impact loads are usually controlled by the use of commercially made energy absorbers[127].

IRATA also advises that equipment designed specifically for work restraint should not be used for work positioning or as fall arrest equipment. Equipment designed specifically for work positioning should not be used as fall arrest equipment. Some equipment is designed to allow the attachment or connection of other components in order to meet the requirements of a category of work other than the one for which it was primarily designed. An example is a sit harness (for work positioning) which is designed to accept the connection of a chest harness which will allow these two combined parts to meet the requirements of a full body harness (for fall arrest). IRATA points out that while the purchasers should ensure any components in any system is compatible and that the safe function of any one component does not interfere with the safe function of another, the user of equipment should only use it in accordance with the information supplied by the manufacturer. The equipment chosen should be able to withstand any loads or forces that might be imposed on it, plus an additional adequate safety margin, and the rope access system itself should be designed to minimize the potential loads placed upon it. The rope access system generally should be designed to avoid a fall. No item of rope access equipment should be capable of being accidentally removed, dislodged or become unfastened from the anchor lines during use. When choosing equipment for a particular application, account should be taken of weakening factors, such as the loss of strength at knots. Rope access technicians should be aware that climatic conditions can affect the performance of some equipment or combinations of equipment. For example, humidity can alter (reduce) the friction provided between the descending device and the anchor line, and thus the performance is altered. This also applies to some ascending devices. Cold conditions can also affect performance, e.g. icy anchor lines can affect the grip of anchor line devices on them. Wet anchor lines can exhibit greater elongation characteristics than dry ones and wet polyamide anchor lines tend to be less resistant to abrasion. In very cold conditions, the strength of some metals is affected. Rope access technicians should check the information provided by the manufacturer to determine the acceptable operating conditions. IRATA also recommends purchasers to check with

[127] IRATA International Code of Practice for Industrial Rope Access, page 22, IRATA International, http://www.google.co.uk/url?url=http://irata.associationhouse.org.uk/show_doc.php%3Fdoc_id%3D3684&rct=j&frm=1&q=&esrc=s&sa=U&ei=Vtj2VOq6HtbvaPKtgZgD&ved=0CBsQFjAA&usg=AFQjCNG8WJRiIavWstNNSq8wSVJPz73JXA

equipment suppliers that equipment made from man-made fibres, e.g. polyamide; polyester; polyethylene; polypropylene; aramid, is protected against ultra-violet light (UV) as most standards do not have requirements for resistance to UV degradation. UV is emitted by sunlight, fluorescent light and all types of electric-arc welding. The normal way to provide protection is by the inclusion of UV inhibitors at the fibre production stage but there are other possibilities, such as the type and colour of any dye used or the use of a protective covering[128].

As for the anchors and rigging, IRATA recommends the following the following points for consideration when rigging on WTGs:

a. IRATA International Level 3 rope access safety supervisors should be competent to select, assess and use anchors. These should be unquestionably reliable and used in accordance with any site-specific requirements.
b. It should not be assumed that the presence of installed anchors means they are suitable for rope access, e.g. non-certified anchors installed in fiberglass housings.
c. The suitability of designated anchor points should be confirmed prior to rope access use, (as should those used for lifting equipment).
d. Where appropriate, it is recommended that anchor lines are 'rigged for rescue', e.g. they utilize releasable systems with additional rope to allow for remote lowering to a safe place.
e. Where appropriate, it is recommended to rig for evacuation, e.g. provide additional escape anchor lines. These should not interfere with any evacuation system already installed.
f. Edges should be adequately protected from contact with the anchor lines, e.g. by rigging to avoid them or by edge protectors such as rollers or plates.
g. Anchor lines should be adequately protected from contact with any sharp, abrasive, hot or moving surfaces, e.g. by rigging to avoid them or by the use of appropriate anchor line protectors.
h. Rigging and working method should mitigate risk against bellowing of the safety line, e.g. caused by wind, and rope stretch[129].

   IRATA also makes recommendations for the care and maintenance of equipment and states that the following should be taken in account of:

a. The need to check for and avoid abrasion to equipment made from textiles, e.g. the rear of the harness when ascending or descending the ladder in the tower.
b. The possibility of contamination of equipment, e.g. by chemicals.
c. The possibility of corrosion of equipment by salt water.

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[128] IRATA International Code of Practice for Industrial Rope Access, page 23, IRATA International, http://www.google.co.uk/url?url=http://irata.associationhouse.org.uk/show_doc.php%3Fdoc_id%3D3684&rct=j&frm=1&q=&esrc=s&sa=U&ei=Vtj2VOq6HtbvaPKtgZgD&ved=0CBsQFjAA&usg=AFQjCNG8WJRiIavWstNNSq8wSVJPz73JXA

[129] Application of IRATA International Rope Access Methods for Work on Wind Turbines, page 5, IRATA International, 2014, http://irata.associationhouse.org.uk/default.php?cmd=210&doc_category=390

d. The need to clean and store equipment properly.
e. That offshore equipment should be transported in waterproof bags suitable for marine transfer.
f. That before use as anchor lines, ropes are conditioned to wet to ensure that any shrinkage is kept to a minimum.

As for the harness, IRATA state the fact that historically rope access technicians used a sit harness coupled with a chest strap or chest harness, which served a dual purpose of holding the chest ascender in its correct orientation and in assisting the user to be supported in a more upright position than typically a sit harness would do alone. Although this combination is still common, an alternative is to use a specially designed full body harness that combines the necessary sit harness support function with the facilities described above and which also provides a high attachment point for the backup device (typically via a short device lanyard). In the unlikely event of a fall, the wearer is always maintained in an upright position and, arguably, the potential for hyperextension of the head (whiplash) is reduced. These harnesses usually conform to appropriate fall arrest harness standards and thus meet legislative and other authority requirements or recommendations for harnesses to be used for work where a fall could occur. IRATA also suggest the following selection criteria for harnesses:

a. the ability to be adjusted to fit the rope access technician for size and comfort when wearing a maximum and a minimum of clothing.
b. whether to use a sit harness or a full body harness (check industry and legislative requirements).
c. suitability for the amount of support needed, dependent upon the person and the work to be done.
d. suitability of the harness attachment points for ascending devices, descending devices, back-up devices, device lanyards and anchor lanyards.
e. the ability to connect and work with a seat.
f. resistance of creep (slow slippage) of straps through their adjusters.
g. resistance to ultra-violet degradation.
h. resistance to chemicals, wear and abrasion.

Connectors, descending devices, ascending devices, back-up devices, lanyards, slings must all have adequate strength, have energy absorbing characteristics particularly for device lanyards and anchor lanyards and be compatible with the connectors being used, e.g. fits through the connector gate and does not bunch and distort unduly under load, as applicable. Anchors, protectors for anchor lines, work seats, pulleys, helmets, clothing and other PPE must be for purpose.

It is recommended that BSEE requires all OWF/ONWF owners/operators to adhere to IRATA International rope access methods for work on wind turbines.[130] IRATA International's rope access

[130] Application of IRATA International Rope Access Methods for Work on Wind Turbines, IRATA International, 2014, http://irata.associationhouse.org.uk/default.php?cmd=210&doc_category=390

system is a safe method of working at height, where ropes and associated equipment are used to gain access to and egress from the work place, and to be supported at it. IRATA guidelines includes procedures for internal access fall arrest and rope access, external access rope access/work positioning/restraint, rescue, i.e. the recovery of an injured or incapacitated person to a safe place and evacuation, i.e. the exiting of a wind turbine in an emergency to a safe place.

3.9.Critical Components of WTGs and Wind Farms

This section identifies specific components of wind turbines or wind farms that are of particular concern for operators and/or inspectors.

An essential tool when identifying critical components is information about the probabilities of component failures. For many years a valuable source of such information was the German Wind Energy Measurement Program, funded by the German government and run by the ISET. This tracked the performance of around 1,500 wind turbines in Germany for ten years, from 1997 to 2006. It accumulated 15,400 turbine years of operation and created a detailed picture of failure probabilities (see Figure 31 through Figure 34). Also refer to section 3.13.5 for further detail.

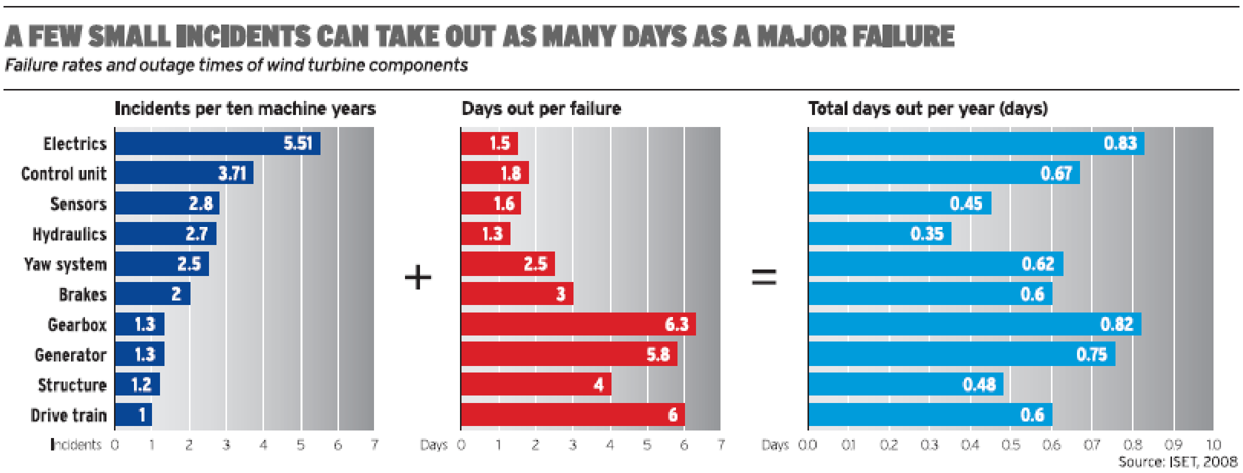

Figure 31 - Failure Rates and Outage Times of WTG Components[131]

The results shows that electrical equipment is the most common cause of stoppages, with approximately 5.5 incidents every ten machine-years. These problems are resolved fairly quickly, however, and the turbines are back in action after around 1.5 days.

Gearboxes, with some well-publicized failures, only account for about 1.5 incidents every ten machine — years, according to the data. But when a gearbox fails, the outage time is much longer, at over six days.

Other studies showed nearly similar results:

[131] Breaking down the cost of wind turbine maintenance, David Milborrow, 2010
http://www.windpowermonthly.com/article/1010136/breaking-down-cost-wind-turbine-maintenance

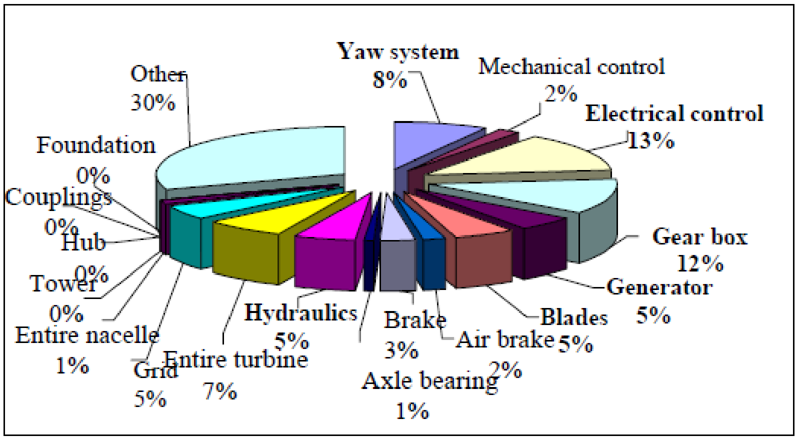

Figure 32 - WTG Component Failures in the UK[132]

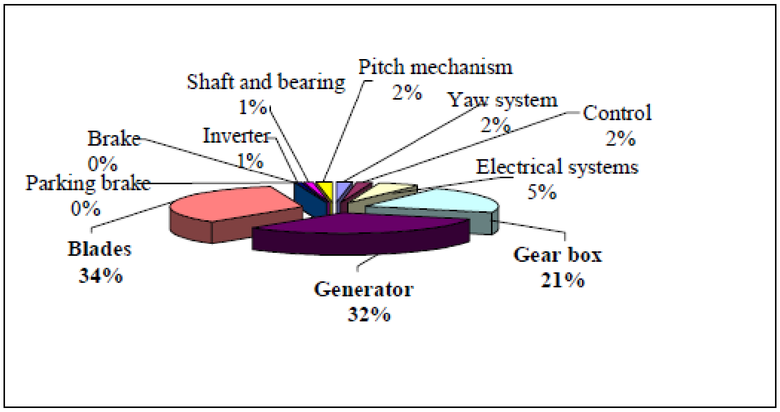

Figure 33 - Causes of Offshore WTG Failures in the Netherlands[133]

[132] CREST Loughborough University
http://www.hie.co.uk/Renewablesseminar-04-presentations/crest-david-infield.pdf

[133] ECN
http://www.ecn.nl/docs/dowec/2003-EWEC-O_M.pdf

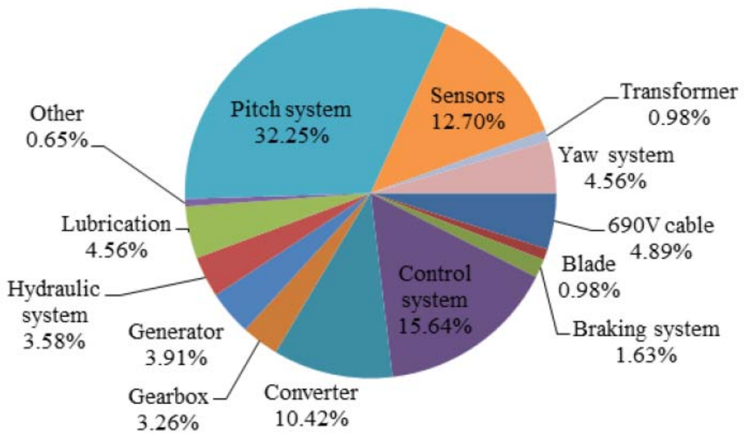

Figure 34 - Failure Percentage for Subsystems, Equipment and Components[134]

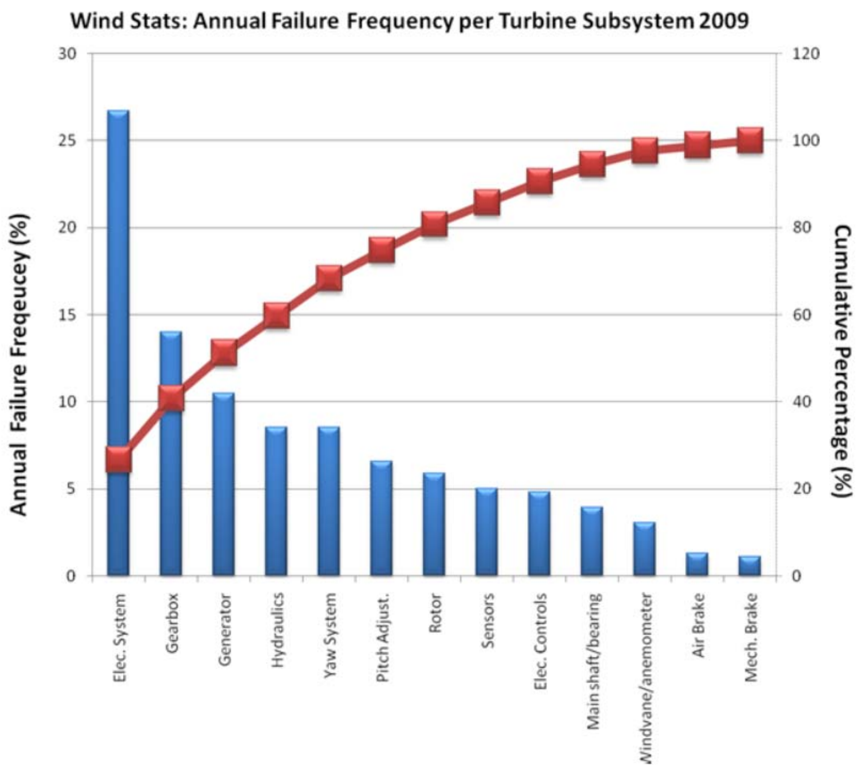

Figure 35 - Annual Failure Frequency per Turbine Subsystem 2009[135]

Figure 35 - Annual Failure Frequency per Turbine Subsystem 2009 shows the percentage breakdown of failures that occurred from January to June in 2011. The majority of failures (32.25%) were linked to the pitch system followed by control system (15.64%) and sensors (12.7%).

[134] A survey of failures in wind turbine generator systems with focus on a wind farm in China,

[135] Investigation of Various Wind Turbine Drivetrain Condition Monitoring Techniques, NREL, August 2011

The main critical components of a wind turbine are:

a. Electrical System
b. Gearbox
c. Generator
d. Control System
e. Sensors

Further critical components are:

Wind Turbine Structure:

a. Tower – welded steel connections
b. Hub – cast steel
c. Blade – glass fiber reinforce plastics (GPR), carbon fiber, composites
d. Nacelle – made of cast steel, welded steel connections
e. Gear Box – gears, shafts
f. Yaw and pitch mechanism – gears, ring
g. Bearings

Support Structure:

a. Transition node – welded steel connection, grouted connection
b. Jacket substructure – welded steel connections, cast steel nodes
c. Tripod substructure – welded steel connections

Other:

a. Hydraulics
b. Cables(wind turbine) and Inter Array Cables
c. Transformer & Converters (Offshore Substation)

Stepping aside from the "component" concept of offshore WTG and looking at the whole power generation concept covering the entire OWF instead, it is seen that the critical components are the substation, the inter-array and export subsea cables. Especially the export and inter-array cables are exposed to a hostile, high-risk environment during an OWF's operational life. Given that they comprise a hefty portion of an offshore wind farm's capital expenditure costs, preventive maintenance for submarine conductors should be a priority for operators.

A wide range of variables can affect the lifecycle and reliability of subsea cabling, with a significant impact on operational expenditure. Seabed conditions, wave action and tidal effects, coupled with ship transit and fishing activity take a heavy toll on the submarine conductors. As such, the level of exposure of conductors should be a critical design driver in accordance with the authors of the latest Wind Energy

Update Offshore O&M report[136]. Cable owners combat the threat from fishing by using cable awareness projects[137], where cable information is freely given to fishermen across Europe in the hope they will avoid fishing over cables.

Fortunately for operators, many variables such as dragged anchor, plough tipping, water damage, J-tube damage and cable faults, among other things, are insurable. However, activities around the offshore wind park will likely lead to considerable seabed disruption, warns the report.

For developers and operators to accurately assess the impact of maritime activities on cable faults, disruption should be expected and accounted for. Bottom fishing, for example, is widespread on most continental shelves and adjacent continental slopes, and can be expected to have a significant impact on export cable integrity, say the report's authors.

Because the offshore wind industry is at a nascent stage, mature and proven maintenance models have yet to emerge. As such, the report highlights areas to which careful attention should be paid. Cable integrity monitoring, spare cable, and joint availability, cable re-laying, joint/splicing expertise availability are among the key recommendations set out in Wind Energy Update's latest report.

Providing a comprehensive overview of an offshore wind farm's cable fault landscape, the Wind Energy Update Offshore Operations and Maintenance report lists noteworthy incidents where invaluable lessons learned can help shape cable O&M plans. The key, say the authors, is to avoid repeating events such as that incurred during the construction phase of Horns Rev I. In this particular incident, a construction vessel's anchor hit an export cable that lay bared on the seabed, resulting in a staggering unforeseen cost of €2 million.

Timescales to repair a submarine power cable can vary from weeks to many months, dependent on ship and cable availability. Various methods can be undertaken to obtain a measurement to the damage point. Once a measurement is obtained the repair ship will usually arrive within close proximity of the damage location. To repair a damaged cable it must be brought to the surface and be in two separate pieces. The two original ends of the damaged cable cannot simply be re-jointed together as there is not enough slack in the cable to allow this. Therefore a piece of stock cable is spliced into the original cable to connect the two original ends. Every time a cable is repaired, it is extended a bit longer than when originally laid.

3.10. Load Impact and WTG Design

This section addresses which components are susceptible to fatigue, wear, or other cyclic loading failure modes and how these performance issues are addressed in wind turbine design.

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[136] http://www.windenergyupdate.com/offshore-wind-energy-operations-and-maintenance-report/?utm_source=PRWeb%2BPressRelease%2B2511&utm_medium=PressRelease%2B2511&utm_campaign=2060

[137] Such as www.kis-orca.eu

Offshore wind turbines and support structures are constantly subjected to cyclic loading for their entire lifetime. The magnitude and impact of the load on fatigue and wear of the structure greatly depends on the severity of the environmental conditions, including wind, wave, current and geotechnical, as well as the geometry and material composition of the structure.

In general, offshore wind turbine design guides and standards, such as the ABS Guide for Building and Classing Bottom-Founded Offshore Wind Turbine Installations, IEC 61400-3, DNV OS-J101, GL Guideline for Certification of Offshore Wind Turbines (and others) require a very extensive, site-specific loads analysis to be undertaken during the design of the wind farm, which typically can involve the simulation of many thousands of different scenarios, each depicting various environmental conditions, faults, or events that are both likely and unlikely to occur during the life of a wind farm.

The fatigue and extreme loads are calculated based on Design Load Cases (DLCs), which are defined in the chosen design standard, however for offshore wind farms, most standards deviate only slightly from the DLCs outlined in IEC 61400-3[138]. The number of dynamic load cases and combinations evaluated for a single offshore wind turbine is typically in the thousands. Each case is performed by simulating the wind, waves, and current conditions to structural assess loads and stresses in a computer model of the complete structure. The extreme loads resulting from simulations are used to evaluate the strength of each member or structural component the tower, substructure and foundation. Operational and idling cases are also used to assess the fatigue lifetime each structural component and verify compliance with the intended design lifetimes.

The load simulations are done mainly to ensure the safety and reliability of the primary steel (wind turbine, tower and support structure), however the adequacy of secondary steel (landings, decks, walkways, etc.) is also considered.

Main structural components of offshore wind turbine components that are susceptible to failure include:

a. Transition pieces with grouted connections
b. Bolts
c. Flanges
d. Rotor Blades
e. Gearboxes
f. Bearings
g. Welded connections

Secondary components that are susceptible to failure include:

a. Attachment points
b. Gratings
c. Ladders and handrails
d. Coatings, paint and corrosion protection

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[138] Section 7.4

3.11. Inspection Requirements of Wind Farms

This section addresses which components require or should require inspection (e.g., blades, rotor assembly, nacelle components, electrical transformer components, control systems, tower structure, foundation, scour protection).

In the MMS TA&R Project 627 – Inspection Methodologies for Offshore Wind Turbine Facilities Report, there are recommendations for inspection cycles for different parts of the offshore wind turbine components. While it is stated in the report that inspection cycles of above water mechanical and electrical system are driven by maintenance requirements of equipment manufacturers, they suggest inspections other components in intervals as shown in the Table 35 below.

Facility Area	Annual	Intermediate	Extended	Additional
Subsea Structure	1	3-5	6-10	As needed
Subsea Equipment	n/a	3-5	n/a	As needed
Above Water Structure	1	3-5	n/a	As needed
Above Water Systems[1]	n/a	n/a	n/a	n/a
Blades	1	3-5	n/a	As needed

Table 35 – Inspection Cycles Recommended by Energo[139]

The inspection cycles shown in the Table 35 are driven by structural integrity concerns without consideration of safety aspect. In fact, complete reliance on the manufacturers' maintenance requirements for equipment is also inadequate in determining the inspection intervals from the safety point of view, because reliability of equipment from the safety and structural integrity standpoint will vary based on installation practices, maintenance practices and environmental conditions. For example, if a component is not properly installed as recommended by the equipment supplier of wind turbine manufacturer, the simply reliance on the maintenance manual will not suffice; because the improper installation practices may cause mechanical failures resulting in incidents, which may jeopardize the safety of wind turbine maintenance technicians in the worst case scenario. For example, an onshore wind turbine, which was one of 56 installed in North-West Coast of Turkey, caught fire only six months after the commissioning; the fire spread quickly burning down the complete wind turbine. The forensic investigation showed that the fire was caused by incorrectly installed cables in the nacelle; the incorrectly installed cables snapped when nacelle rotated, causing fire to start and spread rapidly. While whole asset was a write-off, fortunately no one was hurt in this incident.

This example shows that complete reliance on the manufacturer recommended inspection scheme is inadequate. Likewise, unanticipated extreme weather conditions such as extreme cold temperatures resulting in greater ice build-up on blades may affect the load distribution in rotor blades, which may cause greater wear and tear in the bearings and consequently resulting in damage in the gearbox; while such incidents may result in mechanical failure in a WTG, the incidents such as ice build-up on rotor

[139] MMS TA&R Project 627 – Inspection Methodologies for Offshore Wind Turbine Facilities Report, page 18, Energo Engineering Inc, Houston, January 2009

blades presents safety risk for nearby structures or dwellings for ONWFs and risk for crew in transport/maintenance vessels for OWFs.

In Europe, there were several incidents where big ice pieces were thrown a great distance by rotating blade into residential homes shooting through windows of properties. Again luckily no was ever hurt as a result of such incidents but the experience left local communities, which live nearby ONWFs, with less amicable view to ONWF developments. Those occurrences concerning safety of turbine technicians, public and environment have demonstrated that the inspection intervals must be determined on a combination of variable including WTG manufacturer's maintenance requirements, installation practices, environmental conditions and site requirements.

The MMS TA&R Project 627 – Inspection Methodologies for Offshore Wind Turbine Facilities Report[140] also recommends visual inspection cycle to be performed using divers or ROV at a 3 to 5 year interval for detecting cracks or indications at welded joints or circumferential welds or cracks or spalling of concrete especially at joints, penetrations and around embedded plate.

It is recommended that BSEE require OWF owners to assign a third party to carry out more cost effective and regular inspections for this rather important structural integrity monitoring process which has great deal of bearing on the safety of maintenance personnel in case of a structural failure during the maintenance of a WTG. Therefore, it is recommended that strain gauges (sensors) to be installed near two circumferential welds (upper and lower level) at the transition piece (TP) level and also sub-sea strain gauges to be installed near two circumferential weld (upper level and near mudline) under water at the monopile level at the manufacturing stage; all sensors can be connected to a data logger, which can be positioned in the TP on the dry deck connected to the control room onshore via fiber optic cable for regular condition monitoring. This practice will not only reduce the cost of inspections drastically, it will also enable reliable structural condition monitoring on a regular basis while mitigating relevant safety hazards in the process. It should be remembered that underwater inspections carried out by divers present major safety risks, hence utilizing such online structural condition monitoring for the foundations and transition pieces will eliminate the safety risks involved in diving practices.

This part of the study we addresses wind farm component inspection requirements from the safety point of view in terms of inspection techniques and frequencies while critically assessing the viability of common inspection practices. For example, according to MMS TA&R Project 650–Offshore Wind Turbine Inspection Refinements Report,[141] "*Input from industry experts indicates that UT and thermography are techniques that are used on blades in situ depending on the goal of the inspection and the type of blade being inspected;*" although thermography is one of the safest blade inspection techniques when carried out from ground on a wind farm site, it is not necessarily a viable option for those wind farms where outdoor temperatures are below desirable levels to obtain reliable inspection results, as thermography

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[140] MMS TA&R Project 627 – Inspection Methodologies for Offshore Wind Turbine Facilities Report, page 19, Energo Engineering Inc, Houston, January 2009

[141] MMS TA&R Project 650 – Offshore Wind Turbine Inspection Refinements, page 12, Energo Engineering Inc, Houston, Jun 2010

technique will not detect defects properly in cold temperatures; so this technique is not recommended for rotor blade inspection in wind farms where outdoor temperatures are not warm enough to facilitate reliable thermography blade inspections. Therefore, this study only focuses on viable inspection techniques with emphasis on safety aspects of those inspection procedures. Table 36 below lists the minimum inspections requirements for safe operations of OWFs. Except for the offshore specific inspections, same inspection regime can be implemented for the ONWFs as well.

Part	Nature of Inspection / Possible Defects	Inspection Frequency[142]
Bedplate	Condition, corrosion, damages, welds, bolted connections	Every year
Control cabinets	General conditions, corrosion, grounding, ventilation, attachment, cable routing, chafe marks, arcing evidence, cleanliness, wiring connections, UPS test, infrared scan as required	Every year
Control system	Functionality, plausibility, limit values, error messages	Every year
Converters	Functionality, general condition	Every year
Corrosion protection system	Functionality, general condition	Every year
Down tower assembly electrical connections	Fastening, function, corrosion, dirt	Every year
Electrical installations such as earthing system	Functionality, general condition	Every year
Foundation, subsea and topside built-in parts, tension anchor	General condition, sign of movement, damages, cracks, corrosion, sealing joint, water drain, grout conditions, soil erosion, disturbances, flange welding, anchor bolts	Every year
Gearbox	General conditions	Every year
Gearbox	Conditions of bearings and wheels	Every year

[142] Inspection frequency is based on best practice. Inspection frequency will also depend on local requirements, certification guideline requirements laid down in the project certification / type approval reports / certificates etc.

Part	Nature of Inspection / Possible Defects	Inspection Frequency[142]
Gearbox	Oil level and condition	Every year
Gearbox	Noise, visual inspection through inspection port, wear of gear teeth, chips, scuffing, micro-pitting, contact pattern position	Every year
Gearbox	Endoscope inspection	Every year
Gearbox - Heater, cooler, fan	Leaks, damage and connections, functionality	Every year
Gearbox - Pumps and motors	Noises, leaks, functionality	Every year
General condition, nacelle cover	Overall integrity, safety and cleanliness	Every year
Generator	General condition	Every year
Generator	Check for cracks, corrosion, air gap, bolts, insulation	Every year
Generator	Bearing noises, fastening at machine footing, grounding, junction box, brushes abrasion, breaker, slip ring	Every year
Generator	Megger test	Every year
Generator	Endoscope inspection	Every year
Generator - Fan and exhaust	Damage and connections	Every year
Generator - High speed rotor lock	Functionality	Every year
High Voltage Equipment	Functionality	Every year
Hub	Exterior and interior conditions	Every year
Hub	Latches and Hinges	Every year
Hub	Cracks, corrosion, paint	Every year
Hub	Torque marks	Every year

Part	Nature of Inspection / Possible Defects	Inspection Frequency[142]
Hub - Blade Bearings	Lubrication, noise, corrosion, leaks, condition	Every year
Hub - Pitch Motor	General conditions, corrosion	Every year
Hub - Pitch Motor	Wear	Every year
Hub - Pitch Motor	Lubrication	Every year
Hydraulic system	Damage, leakages, corrosion, function	Every year
Lightning protection system	Functionality, general condition	Every year
Low-voltage Switchgear, Control gear and Switchboards	Functionality, general condition	Every year
Met-Mast	Foundation, ladders and equipment such as such as anemometers, wind vanes, booms, aviation lights	Every year
Nacelle	Exterior condition, hatches, corrosion, damages	Every year
Nacelle - Brakes	Caliper and pads: wear, air gap, springs, corrosion, pressure, leaks	Every year
Nacelle - Brakes	Disc: profile, color, true running	Every year
Nacelle - Brakes	Functionality, activation time	Every year
Nacelle - High Speed Coupling	Condition, wear	Every year
Nacelle - Locking device (rotor lock)	Functionality	Every year
Nacelle - Roof	Safety hooks, safety rails	Every year
Nacelle - Up Tower Transformer (where applicable)	General condition, protection against infiltration of water and plant/animal intrusion	Every year

Part	Nature of Inspection / Possible Defects	Inspection Frequency[142]
Nacelle - Up Tower Transformer (where applicable)	Monitoring devices for temperature and pressure	Every year
Nacelle - Wind vane and anemometer	Visual inspection, functionality	Every year
Nacelle - Yaw bearing	Lubrication, noise, corrosion, leaks, condition	Every year
Nacelle - Yaw toothing	Tooth chippings, lubrication, contact pattern, wear	Every year
OSP Substructure	General condition, sign of movement, damages, cracks, corrosion, sealing joint, water drain, grout conditions, soil erosion, disturbances, flange welding, anchor bolts	Every year
OSP Top Side	Condition and functionality	Every year
Rotor Blade	Visual control regarding cracks, blowholes, delaminating, drainage, protective film and erosion at the leading edge, lightning, spark gap, bearing seals.	Every year
Safety Equipment - Brake calipers	Wear, air gap, springs, corrosion, leaks	Every year
Safety Equipment - Climb assist/ cranes	Functionality of tool-lift, tower crane, davit crane, OSP crane, boom, hoisting, crane mats	Every year
Safety Equipment - Ladders and safety cables	Assembly, visual inspection and functionality of fall protection, safety plates, platforms and railing	Every year
Safety Equipment - Locking devices	Functionality	Every year
Safety Equipment - Man lifts	Functionality of man-lift	Every 6 months or every year depending on local regulations.
Safety Equipment - Safety rails	Functionality, corrosion, fixing	Every year

Part	Nature of Inspection / Possible Defects	Inspection Frequency[142]
Scour protection system around the foundations and ground conditions	Condition and functionality[143]	Every year
Subsea Cables	Cable burial depth, integrity of the cable and cable protection system (i.e. bending restrictors and bend stiffeners)[144]	Every 6 months for the first three years and every year thereafter
Tower including platforms and doors, etc.	Lighting (interior and exterior), exterior paint, exterior stairs and door, platforms, hoist and hatches, cables and splice conditions, torque marks at tower section, corrosion, cracks, welds	Every year

Table 36 – OWF Inspection Requirements

3.12. Inspections Frequency

This section addresses how frequently these critical components should be inspected. Table 36 above shows the recommended inspection frequency for components in WTGs, OSPs and Met-Mats.

For Offshore-WTG substructures the recommended inspection frequency is, as outlined in section 2.11, annually to a minimum of 20% of the Offshore Wind Substructure Installations in the Wind Farm.

It is recommended that BSEE require offshore wind farm owners to install on each substructure Condition Monitoring Systems (CMS) and to implement the monitored data analysis into the SCADA system to be able to reduce inspection frequency, costs and at the same time increase the surveillance quality of the structure. Since now the Germany authority BSH requests in their standard that 10% of the substructures of a wind farm have to be equipped with CMS. It is currently under discussion by the BSH and other organizations how many wind turbine substructures in a wind farm have to be equipped with which CM-Systems to be able to reduce the inspection frequency.

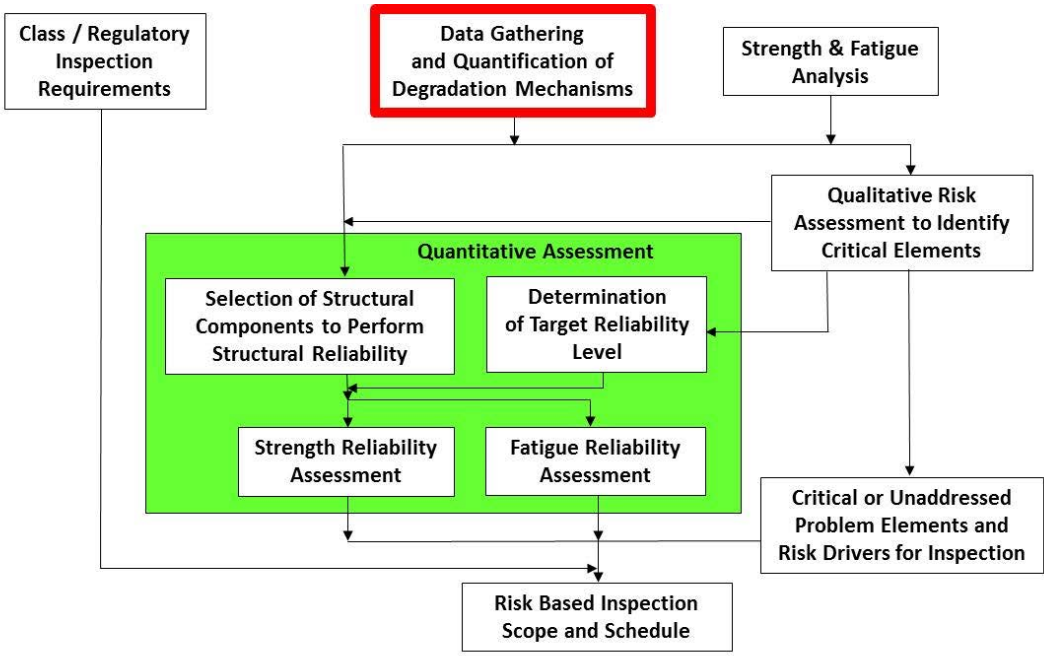
[143] As stated in the Burbo Bank Extension OWF Environmental Statement, the same vessel carrying out the routine cable inspections will also cover the inspection of the ground conditions and scour protection around the foundations and a general survey of the wind farm subsea conditions.

[144] In the Burbo Bank Extension Offshore Wind Farm, Environmental Statement it is stated that the preventive maintenance would primarily be undertaken using special-purpose vessels (such as cable-survey vessels) and would include routine inspections to ensure the cable is buried to an adequate depth and not exposed. The integrity of the cable and cable protection system (i.e. bending restrictors and bend stiffeners) will also be inspected.

3.13. Risk-Based Inspections

This section addresses which aspects of OWFs should trigger inspections.

RBI begins with the recognition that the essential goal of inspection is to prevent incidents that impair the safety and reliability of operating facilities such as offshore and ONWFs. As a risk-based approach, RBI provides an excellent means to evaluate the consequences and likelihood of component failure from specific degradation mechanisms and develop inspection approaches that will effectively reduce the associated risk of failure. RBI is a process that assures inspection resources are focused on the areas of greater concern, and provides a methodology for determining the optimum combination of inspection methods and frequencies. As a result of this there is a continuous improvement aspect to the RBI process, which is shown on Figure 36 below, allows for recalculation of risk and subsequent refocusing of the inspections activities.[145]



Reference: *ABS Guide for Risk Based Inspection of Hull Structures, 2007*

Figure 36 – RBI Process

Over the years wind energy industry experienced swift improvements in wind technology but also witnessed a number of serious accidents, some of which resulted in fatalities. The HSE statistics that are available in Europe clearly show the areas of risks in wind farm transportation, installation and operation phases. A small number of ONWF decommissioning activities are yet to demonstrate any significant issues regarding safety to people and environment as this report is being written. Based on the risks identified in OWF and ONWF transportation, construction and operation phases, it is recommended that BSSE or a designated third party to carry out a number of inspections, which have

[145] ABS Guide for Surveys Using Risk-Based Inspection for Offshore Industry, ABS, 2003, Houston, http://ww2.eagle.org/en/rules-and-resources/rules-and-guides.html#/content/dam/eagle/rules-and-guides/current/offshore/120_surveys_riskbasedinspectionoffshoreindustry

bearing on the integrity and safety of wind turbine components and adjacent facilities such as substations, to be carried out. Those risks and relevant inspections are discussed in this section.

The oversized components of wind turbines present considerable risk during transportation on land and at sea. Almost every single major components of WTGs including rotor blades with large diameter and considerable length (up to 80 meters), as shown in Figure 37, foundations, transition pieces (for offshore WTGs) and tower sections with large diameters and long lengths and nacelle with oversized dimensions all present major logistic and safety challenges when transporting them in land and offshore. The lifting any of those components is along a major safety risk when carrying out loading, unloading and installation activities both onshore and offshore. Likewise loading and installation of OSPs are also risky activities as it involves lifting and positioning of very heavy structures. Therefore, the ordinary loading, transportation, unloading and installation activities represent high safety risk caused by the nature of the WTG components and OSPs.

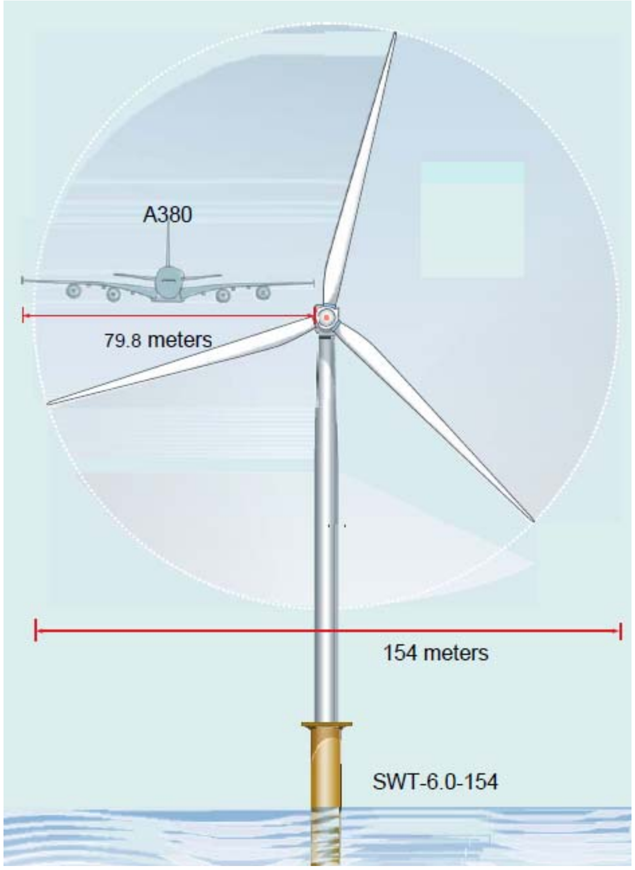


Figure 37 – Size of a New Generation WTG (Siemens SWT-6.0-154[146])

[146] Siemens D6 platform – 6.0-MW Direct Drive Wind Turbine,

http://www.energy.siemens.com/hq/pool/hq/power-generation/renewables/wind-power/platform%20brochures/D6%20Offshore%20brochure_English_Apr2014_WEB.pdf

3.13.1. Onshore Transportation

Most accidents involve turbine sections falling from transporters, though turbine sections have also been lost at sea, along with a 58 million Euro barge. From the accidents reported in relation to wind farms, transportation is the single biggest cause of fatalities for workers, and this includes transport workers. The hazards associated with the transport of wind turbine components include:

a. People and load falls: An unsecured load that shifts is more difficult to unload. Sending someone up onto the trailer bed to handle a load that has shifted puts them at risk of falling.
b. Vehicle Rolls: Vehicles can roll over; in serious cases of load shift, the vehicle can become unbalanced and overturn.
c. Load shifts forward: If there is a gap between the load and the headboard, the load can shift forward under braking, risking the life of the driver and other road users.
d. Collision with other Vehicles: Some of the remote locations used for wind farm sites will require the use of minor roads and track roads for the transportation of wind turbine components. Owing to the size and length of these vehicles there will be occasions when they have to cross the center line of a road or even move along the wrong side of a roundabout, and this can put other road users at risk.
e. Road Restrictions: The dimensions of the transporters will create hazards associated with height and weight restrictions when travelling along bridges, tunnels, etc.
f. Fatigue: Caused by driving excessive distances without an appropriate break. Sleep-related accidents are most likely to occur between 2 a.m. and 6 a.m. and between 2 p.m. and 4 p.m., which are times when abnormal loads are being transported.[147]

According to Irish Wind Energy Association (IWEA) research,[148] 50% of transportation incidents on wind farms are caused by human-related behavior, such as moving off the center line of the road. If the vehicle becomes stuck, the driver may attempt to maneuver out of difficulty by moving off the center line of the road without appropriate assistance, leading to a more serious incident. However, better planning should ensure that assistance is readily available, which can prevent the driver needing to move off the center line of the road or getting stuck. As early as possible in the design phase of the transportation project, key points such as those mentioned above need to be taken into consideration. This could include provision of escorts, contingency planning, identification and avoidance of restricted

[147] Occupational Safety and Health in the Wind Energy Sector, European Risk Observatory Report, pages 33, 34, European Agency for Safety and Health at Work, 2013, Luxemburg https://osha.europa.eu/en/publications/reports/occupational-safety-and-health-in-the-wind-energy-sector

[148] Draft IWEA Standard Transport of Abnormal Loads Consultation, Irish Wind Energy Association, page 23,

http://www.iwea.com/transportation

access routes, steep gradients, confined road corridors, road traction, limited turning points or forms of communication.[149]

As suggested in the European Risk Observatory Report, one way of reducing the risks associated with transport accidents by better planning is to undertake a swept path analysis, which is a tool that can help anticipate and avoid dangerous situations when transporting turbine components. There could be several routes to a site and, through the use of computer simulations; it is possible to pinpoint the areas where additional information is required. By doing so, exposure to the dangerous parts of a road would be limited. In some cases it is even possible to have 'dry runs' (real trucks simulating the actual deliveries to site) that can help assess situations that could become dangerous for the drivers and other road users. These dry runs can confirm the suitability of an access route and will help to ensure that the actual delivery is undertaken in a safe manner.

As main roads are used to transport turbine components, the effect and impact of this transport on the safety and convenience of other road users also needs to be considered. To avoid interference with the main traffic flows, the majority of turbine traffic movement is done at night, although this is not always possible. An example of the transport of turbine components affecting the safety of other road users is when the transportation is done in convoys. This prevents other road users from seeing around all the vehicles and, with a safety distance of 60 meters between, it is impossible for a vehicle to overtake three trucks in a safe manner. In situations like this, the use of escort vehicles is necessary. The main functions of escort vehicles are to:

a. Provide an element of control on road users along particular sections of the route, e.g. when a load must cross the center line of a road or move along the wrong side of a roundabout; and
b. Provide an element of warning and information for other road users about the proximity of the convoy.

Escort vehicles are also needed if road transport legal weights or minimum dimensions are exceeded. Overall, there is a need for more risk awareness among transporters. They typically work long hours, at night and sometimes also in very poor weather conditions. This is seen as an increasing challenge for the wind energy industry to address.

For OWFs, the transport of turbine components by road can be reduced. Indeed, as the size of wind turbines has increased, there has been a growing trend for manufacturers of wind turbine components to be sited at ports where most of the installation can be assembled before being transferred directly to specialist wind turbine installation sea vessels. In Denmark, Germany and the United Kingdom there are ports that have been developed for this very purpose. The advantage in terms of safety is that it reduces workers' exposure to risk associated with road transport of components from manufacturing plants to

[149] Occupational Safety and Health in the Wind Energy Sector, European Risk Observatory Report, page 34, European Agency for Safety and Health at Work, 2013, Luxemburg

the port as components no longer need to be transported to the port[150]. We discuss the risks inherent in offshore transportation in the next section.

It is recommended for BSEE to require third party inspections on WTG component transportation to reduce risk of incidents and accidents. The transportation inspections should be carried out by competent third party inspectors at random to ensure that all wind farm onshore transportation activities involving selection of correct transportation tools such as saddles for tower transportation etc., lifting, loading, unloading are done correctly to prevent accidents in the process.

3.13.2. Offshore Transport

European Agency for Safety and Health at Work also addresses the issues around offshore transportation in the European Risk Observatory Report. As stated in this report, compared with road transport, marine transportation can better accommodate very large, heavy turbine components. Transportation sometimes involves a fully constructed wind turbine. The transportation of turbine components offshore poses additional risks to those already considered onshore, such as the following:

a. During a voyage, a vessel is exposed to a number of potential hazards including heavy weather, stranding or collisions and fire.
b. Vessels are subjected to six different motions at sea: rolling, pitching, yawing, surging, heaving and swaying. These motions, particularly rolling and pitching, can be magnified immensely during periods of heavy weather.
c. OWFs are being constructed with bigger power ratings and at locations further from shore, therefore travelling distances are increasing.

3.13.2.1. Access to WTGs

European Agency for Safety and Health at Work's report on Occupational Safety and Health in the Wind Energy Sector provides useful information about the transportation of workers to the project sites. According to European Agency for Safety and Health at Work, no information related to the transportation of workers to ONWFs was found. As they state in the report, transporting workers to an ONWF site can be challenging because of the remoteness of areas often with poor wireless communications facility and difficult road access. So it is important to assess the road access and communication facilities in case of safety emergency.

As stated in the Occupational Safety and Health in the Wind Energy Report,[151] one of the main challenges when working on OWFs is the transportation of workers and their access to the turbines not only in the construction phase but also throughout its entire life cycle. In an offshore environment, the transfer to the wind turbine is not a matter of a few steps on a normal staircase but an operation that

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[150] Occupational Safety and Health in the Wind Energy Sector, European Risk Observatory Report, page 35, 36, European Agency for Safety and Health at Work, 2013, Luxemburg

[151] Occupational Safety and Health in the Wind Energy Sector, European Risk Observatory Report, page 37, European Agency for Safety and Health at Work, https://osha.europa.eu/en/publications/reports/occupational-safety-and-health-in-the-wind-energy-sector

involves the use of fall protection equipment, coordination between technician and vessel crew and additional climbing of ladders of 5 to 20 meters while exposed to the prevailing weather conditions. Offshore workers are normally transported by a vessel that has its own crew. These workers are dependent on a complex logistical arrangement that includes transfer to and from a vessel or helicopter, coordination with other marine vessels, and extra marine rescue equipment (e.g., immersion suits).

3.13.2.2. Vessel Safety

As stressed in the European Agency for Safety and Health at Work report, the selection of vessels for transportation is important to ensure that workers complete their journey safely and that whole body vibration (WBV) and the resulting fatigue and discomfort is minimized so as not to impact on the worker's health and their capability to perform tasks safely. RenewableUK has produced a Vessel Safety Guide[152], which provides guidance to offshore renewable energy developers. The guide considered effective vessel selection and operation and includes examples such as marine and project crew on small vessels being exposed to risk of injury arising from WBV or severe shock as a result of impacts, or the consequential risks associated with vibration that may cause fatigue or discomfort (e.g., sea sickness), which may impact on capability and safety.

3.13.2.3. Emergency Response

The evacuation of sick or injured persons would also need to be addressed when considering the transportation of workers from the offshore WTGs and OSPs back to shore. The following factors need to be taken into account:

a. Evacuating a sick or injured person from the nacelle may be challenging because of ladders inside and outside the wind turbine tower;
b. Evacuating persons from wind turbines as a result of changed weather conditions may also be a challenge;
c. Going further offshore implies that the farms could be beyond the range of rescue boats;
d. Generally, the use of helicopters close to an installation is risky; and
e. The use of a vessel may be a better solution, but it is limited by sea conditions.

At an early stage, emergency and preparedness plans and training sessions should be established, so that workers know what they should be doing in case of an accident or emergency situation.

With an increasing number of offshore developments expected over the coming years, and with these becoming larger and further offshore, special attention needs to be given to how primary medical attendance would be provided. The difficulties of evacuation from OWFs to onshore hospitals have been addressed in research carried out by an interdisciplinary team at the BG Trauma Hospital Hamburg. The 'Rescue Chain Offshore Wind Research[153]' focuses on the development of a rescue chain concept for

[152] Vessel Safety Guide, RenewableUK, London, 2012, http://www.renewableuk.com/en/publications/index.cfm/vessel-safety-guide

[153] Rescue Chain Offshore Wind Research, BG Trauma Hospital, Hamburg, 2010,

trauma patients at offshore wind turbines and is based on a scientific understanding of rescue logistics, techniques and medicine. The ultimate aim is to make recommendations for the future development and implementation of a rescue chain and will address topics such as:

a. Analysis of existing rescue concepts for OWFs
b. Investigation and optimization of existing restraint systems from a biomechanical–medical perspective
c. Needs assessment of tele-medical rescue assistance systems
d. Analysis of previous accident scenarios in terms of necessary classification of trauma patient
e. Injuries, as well as acutely occurring and emergency diseases
f. Analysis of existing safety and emergency training programs
g. Needs assessment of medical supplies and rescue measures, as well as additional PPE or communication facilities from a medical–scientific perspective
h. Needs assessment of professional primary medical attendance
i. Analysis of additional hazards for trauma patients and rescue staff considering the maritime and
j. Environment and offshore weather conditions and development of recommendations for optimum rescue concepts.[154]

Some of the safety considerations include the selection of appropriate vessels, selection of suitable towing equipment, safe practices for line handling, which is laid out in the Merchant Shipping (Code of Safe Working Practices for Merchant Seamen) Regulations,1998 Chapter 33, and the need to consider weather limits and forecasting. The limitation on the number of suitable installation vessels and cranes available for transportation is rapidly becoming a concern, particularly with the increase in number and size of OWF components.

The risks inherent in the offshore transportations are well addressed in the UK Merchant Shipping (Code of Safe Working Practices for Merchant Seamen) Regulations, 1998.[155] It is stated in the Chapter 33.2 that the watertight integrity must be maintained.

a. 33.2.1: The watertight integrity of the tug should be maintained at all times. When a tug is engaged on any towage operation all watertight openings should be securely fastened.

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http://www.buk-hamburg.de/files/rettungskette_offshore_englisch_web.pdf

[154] Occupational Safety and Health in the Wind Energy Sector, European Risk Observatory Report, pages 38,39, European Agency for Safety and Health at Work, https://osha.europa.eu/en/publications/reports/occupational-safety-and-health-in-the-wind-energy-sector

[155] Code of Safe Working Practices for Merchant Seamen, Maritime and Coastguard Agency, the Department for Transport, UK, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/282659/coswp2010.pdf

b. 33.2.2: All watertight openings should be marked with a sign stating that they are to remain closed during towage operations. Any such openings used whilst moving about the tug during a towage operation should be re-secured immediately after use.

The same regulations also require a set of **checks** and **inspections** to be carried out. The regulation 33.3 for testing and inspection of towing equipment stipulates that:

a. 33.3.1: Towing hooks and alarm bells, if fitted, should be inspected daily.
b. 33.3.2: The emergency release mechanisms on towing hooks and winches should be tested, both locally and where fitted remotely, at frequent intervals to ensure correct operation.
c. 33.3.3: All towing equipment in use should be inspected for damage before undertaking and after completing a tow.

The UK Merchant Shipping (Code of Safe Working Practices for Merchant Seamen) Regulations, 1998, Chapter 33.2 also covers crew safety during towing operations.

a. 33.6.1: Once the towing gear is connected, the deck crew should indicate this to the master and then clear the area and, if required to remain on deck, stand in a safe position. If the crew are required to attend the towing gear during a towing operation, the length of time exposed should be kept to a minimum.
b. 33.6.2: During towage operations the towing gear, equipment and personnel should be continuously monitored and any change in circumstances immediately relayed to the master. This is particularly important on tugs where the master has a restricted view of those areas/ personnel.
c. 33.6.3: During all towing operations, where a tug is made fast to the tow, the crew should be aware that the tow may have to be released in an emergency situation, and that this may occur without any warning.
d. 33.6.4: Tug crews should wear appropriate PPE.

Chapter 1, Risk Assessment section of the UK Merchant Shipping (Code of Safe Working Practices for Merchant Seamen) Regulations, 1998 stresses the importance of inspections of safety workers and use of “permits to work” process for the crew safety: “*1.1.9 Regulation of occupational health and safety on board ship is of course not new. Existing safety measures may already provide a high level of safety for workers. For example, well-established procedures, inspections by safety officers and the use of “permits to work” which control safety conditions, will contribute to the identification of hazards and measures for safe working.*”

In fact the requirements for using “permit to work” is a good example and practice in managing risk to crew safety offshore. The permit to work (PTW) system normally includes defining aspects such as:

e. Scope (range of activities) for which the PTW is needed
f. Responsibility for the design of the PTW system and the responsibilities of those involved in its operation

g. Training and competency of those who design or operate the PTW system
h. Communication and consultation needed in the design and operation of the system
i. Arrangement for inspection and audits of the system and its implementation
j. Arrangements to review the performance of the PTW system and determine whether improvements are needed.

It is recommended that BSEE require the audit of permit to work system to ensure that it is used correctly and on a timely basis.

It is recommended that BSEE require third party inspections on WTG component transportation to reduce risk of incidents and accidents offshore. The transportation inspections should be carried out by competent third party inspectors at random to ensure that all wind farm transportation activities involving selection of correct transportation tools such loading frames for tower and blade transportation etc., lifting, loading, unloading, sea-fastening are done correctly to prevent accidents in the process.

3.13.3. Construction

Construction phase of OWF and ONWFs is the most complex and the most dangerous phase in their life cycle. Because this phase involves complex logistic including installation of heavy and oversized components such as foundations, WTG sections, OSP topside; installation of subsea cables also presents safety risk at OWF construction phase. The safety risks not only stem from the installation of those components but also from repetitive nature of the installation activities combined with complex logistics that involves multiple tasks in rapid sequence, which presents a number of safety issues. While the logistics of handling safety aspects of construction activities may be less complex for ONWFs, this drastically changes for OWF projects. This is particularly true for larger OWF projects where multiple installation activities are carried out simultaneously involving a number of personnel working on different aspects of construction activities in an offshore environment in which the wind speeds, wave heights and currents (affecting subsea cable installations and diving activities) have immediate impact on the safety of relevant construction activities. It should be pointed out that the installation of tower sections, nacelle and rotor blades, all of which involve lifting, is highly weather dependent as installation of any of those components will be unsafe at wind speeds exceeding 12 m/s for tower sections, 10 m/s for nacelle and 8 m/s for rotor blades. Therefore, it is very important to assess the safety risks of working offshore and lifting/installing heavy WTG components throughout the construction phase.

It is recommended that BSEE to require OWF owners to assign a third party to carry out inspection of installation procedures covering foundation, transition piece, WTG components, subsea cables, OSP foundation and topside. The inspectors should check the installation procedures, which must be prepared by a construction team based on WTG and site specific conditions; each installation activity should be risk assessed and all installation risk should be reduced as low as reasonably practicable.

3.13.3.1. Offshore Logistics and Activities

In Europe, a number of OWF constructions are in increase. According to the European Risk Observatory Report busy areas such as the North Sea will continue seeing an increase in activities over the next few years. The offshore wind industry is competing for space with shipping lanes, offshore platform operators and other stakeholders. As oil and gas offshore platforms are generally accessed by helicopter, constructing OWFs in the vicinity of these platforms is a challenging business. Consideration has to be given to helicopter safety issues and the amount of time during which a platform is inaccessible should not increase too much. The key construction milestones for a wind farm consist of the following:[156]

Onshore Substation Development

a. Earthworks and screening mounds
b. Construction of access roads
c. Construction of control room
d. Delivery of transformer
e. Internal concrete roads and paving
f. Electrical and mechanical installation
g. Substation commissioning
h. Installation of export cables
i. Construction completed

ONWF

a. Construction of access road
b. Excavation of foundation
c. Steel reinforcement and base
d. Turbine base and transformer housing completed
e. First tower section and nacelle installed
f. Blade fitted
g. Cable routing to substation

Offshore Substation Development

a. Installation of monopile or jacket foundation
b. Assembly of top side
c. Offshore substation commissioning
d. Installation of export cable/s
e. Construction completed OWF
a. Offshore construction base built at port

[156] Occupational Safety and Health in the Wind Energy Sector, European Risk Observatory Report, page 40, European Agency for Safety and Health at Work, https://osha.europa.eu/en/publications/reports/occupational-safety-and-health-in-the-wind-energy-sector

b. Foundation installation
c. Installation of scour protection, where applicable
d. Installation of array cables
e. Installation of WTG components
f. First power generated
g. Final turbine installed
h. Project handed over to operations and maintenance team.

While each of those activities presents safety risks, some of them also present environmental risks. Based on the most prevailing hazards listed below, it is possible to identify the inspection requirements, which should be ideally carried out by third party inspectors with completely unbiased approach:

a. Dropping Objects: Falling structures, loads or objects during lifting operations are the top risks at a wind farm construction stage.

b. Electrical: Short circuits, overcharge, electrostatic phenomena or falls due to electrical shock may cause severe injuries or fatalities.

c. Environmental Effects: Wind, wave and currents and lightning may cause safety risks while working offshore.

d. Ergonomics: Physiological effects as a result of heavy lifting and repeated movements, fatigue from climbing ladders or working in confined spaces may cause major accidents and incidents.

e. Emergency Response: Evacuation of persons from wind turbines as a result of changing weather conditions and locations may be challenging and may cause further safety risks to the rescue team.

f. Exposure: Exposure to noise and vibration, during foundation piling particularly, has safety impact on workers and environments; while high decibel noise may cause hearing problems for workers, the underwater noise may cause behavioral disturbance on marine mammals[157].

g. Falls: Falls from heights while working in and on turbines or installation vessels is another major safety risk.

h. Fire: Fire or explosion of turbine (use of combustible materials) or vessel is unlikely but a possible safety risk.

i. Lightning Strike: The possibility of attracting lightning strikes applies to all tall structures and wind turbines are no different. Even though appropriate lightning protection measures are incorporated in wind turbines to ensure that lightning is conducted harmlessly past the sensitive parts of the nacelle and down into the earth, there is still risk of being hit by lightning strike

[157] Assessing Underwater Noise Levels during Pile-driving at an Offshore Wind Farm and its Potential Effects on Marine Mammals (Abstract), page 891, Helen Bailey, Bridget Senior, Dave Simmons, Jan Rusin, Gordon Picken, Paul M. Thompson, Marine Pollution Bulletin, UK, 2010

when carrying out maintenance in WTG, if the lightning protection system is not properly maintained.

j. Manual Handling: Manual handling risk may result in musculoskeletal disorders (MSDs) such as pain and injuries to arms, legs and joints, and repetitive strain injuries of various sorts caused by a wide variety of activities including lifting, lowering, pushing, pulling and carrying heavy objects.

k. Offshore Environment: Offshore operations and transportation, for example ship collisions or man overboard present considerable risks while working offshore.

l. Organizational/Human factor: Time pressure, insufficient or lack of safety equipment, lack of competence or skills for wind energy sector, different actors/companies all involved in the same operation can cause considerable safety risks.

m. Rotating Equipment: Mechanical hazards, such as contact with moving parts may result in severe injuries or fatalities while working in wind turbines.

n. Working in Confined Spaces: The configuration of all nacelles will classify them as confined spaces; the risks in working in nacelle and rotor blades may result in injuries.

o. Working with Dangerous Substances: Dangerous substance[158] such as epoxy paint which is highly toxic may result in major safety risks.

Based on the risks identified above, it is recommended that BSEE require OWF owners to assign a third party to carry out inspections on OWF and ONWF construction activities to ensure that the each activity is properly planned and risk assessed, all risk mitigation plans are carried out, correct safety procedures are put in place and implemented consistently throughout the construction phase of an OWF and ONWF.

3.13.3.2. Diving

As stated in the RenewableUK Offshore Marine H&S Guidelines, diving is a high-hazard activity that depends upon specialist personnel with a high level of training and experience to plan, support and carry out diving operations in a safe manner; if not properly managed, serious incidents, including fatalities can occur. In the light of the inherent risks involved, a principal objective at the design phase of any OWF development is to aim to prevent or, where not practicable, minimize the need for diving operations. Therefore it is highly recommended that the OWF developer/project owner takes on the following duties:

a. A suitable and sufficient assessment must be made on the risks to health and safety of employees and others who may be affected by work activities.
b. Where measures are taken to reduce the risks that have been identified, then under the principles of prevention, if possible avoid a risk altogether by doing the work in a different way and taking care to avoid introducing new hazards in the process.

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[158] Occupational Safety and Health in the Wind Energy Sector, European Risk Observatory Report, pages 41 European Agency for Safety and Health at Work https://osha.europa.eu/en/publications/reports/occupational-safety-and-health-in-the-wind-energy-sector

The risks involved in diving can be avoided if subsea operations are designed out, or alternative methods such as Remotely Operated Vehicles (ROVs) or Autonomous Underwater Vehicles adopted. However, most offshore projects will still require some diving operations to be conducted before and during the construction phase, and subsequently for certain O&M activities. It is therefore vital that whenever there is a possibility of diving activities, early planning is conducted to eliminate and minimize diving risks.

The principal risk to divers arises from working in the underwater environment, at a pressure that may be several times greater than normal atmospheric pressure. Depending on the depth, divers will either breathe air, or a mixture of gases, at a pressure that matches the water pressure at their working depth; the correct management of breathing gases and decompression is vital to avoiding acute physiological effects (such as decompression sickness), or longer term harm.

The breathing gas is supplied to the diver through an umbilical, which is connected (either directly or through a diving bell) to a support system on the surface, and which also provides for communications. Divers may be vulnerable to a wide range of hazards as a result of the works on site and the inherent nature of the underwater environment. These include, but are not limited to:

a. Differential pressure, for example breaching a seal on a J-tube underwater, could cause a sudden flow of water due to the difference in water levels inside and outside, with the potential to trap and seriously injure a diver
b. Adjacent marine operations involving vessel movement, and particularly the wash and mechanical hazards of propellers and thrusters
c. Any work being carried out above the dive location, presenting the risk of dropped objects
d. Restricted visibility, both on the surface and subsea, which may be further impaired by sediment disturbed by the subsea operations or other simultaneous operations
e. Working with cranes in limited visibility can result in entrapment and crushing, particularly if combined with vessel movement, due to wave action, causing the load to move
f. Underwater noise can impede communication, or, in extreme cases, cause hearing damage
g. Electricity
h. Entrapment or severing of divers' umbilical by vessel thrusters, cables or other equipment
i. Apparently simple dives, such as those in shallow water, can result in complacency in dive planning, and inadequate mitigation of hazards
j. Changes in sea conditions during a dive, which may result in hazardous conditions for divers when exiting the water
k. Many divers are self-employed, so may perform other work during 'rest' periods and also use their own equipment
l. Use of equipment such as high pressure water-jetting, abrasive cutting discs or ultra-thermic cutting lances is particularly hazardous
m. Breakdown in communication, either due to language or equipment issues
n. Poor visibility when carrying out grinding underwater

The unforgiving subsea environment, combined with decompression requirements preventing immediate evacuation, can rapidly escalate the severity of any accident or health issue. The exposure of people to the above hazards should eliminated whenever a method is found to achieve the necessary work objectives without the deployment of divers [159]

It is recommended that BSEE require all OWF owners/operators to prepare RAMS prior to any maintenance or inspections works, which need to be carried out by divers. The RAMS must adequately address all risks inherent in relevant subsea maintenance and inspection activities and all risk mitigation plans must be put in place well in advance. RAMS must be prepared and peer-reviewed by competent people.

3.13.3.3. Component Assembly

As recommended by the European Risk Observatory Report during the construction of OWF installations diving operations and other work carried out offshore should be kept to a minimum, wherever possible, by using ROV or carrying out as much work as possible onshore. While in some cases all the pre-assembly is done offshore, in others turbines are fully assembled onshore and then transported and set up on the substructure as one component. The onshore assembly is done to reduce the risk of collapse of tower and rotor system, which can occur during its installation offshore. This type of failure can arise if the tower-fastening system is not installed properly, possibly because of improper torqueing of the base. In such cases, the tower will fall over as it is loosened and then becomes severed at the base of the flange. The collapse of the tower during the construction phase for both onshore and offshore facilities may have serious consequences in terms of injuries and fatalities[160]. Likewise installation of blades is equally risky activity as blade drop during installation can cause fatalities and severe injuries as we have seen happen in some of the OWF projects in Europe.

Therefore, It is recommended that BSEE demand OWF owners to assign a third party to carry out inspections on WTG component assembly onshore and offshore, diving operations, sea-fastening and rotor blade installation to ensure safe practices throughout the construction phase.

3.13.4. Operation and Maintenance

Unlike offshore oil and gas platforms, operational wind farms are essentially unmanned facilities and the only time workers access them is to carry out maintenance and repair activities, which are normally planned in advance. Therefore while a considerable amount of people work on an OWF construction project, the number of people involved in the O&M phase goes down to handful of people. The normal set up for an OWF O&M team involves a small core team supported by multiple contractors who carry out different maintenance activities.

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[159] Offshore Marine HS Guidelines 2014, page 232, RenewableUK< 2014, http://www.renewableuk.com/en/publications/index.cfm/2013-03-13-hs-guidelines-offshore-wind-marine-energy

[160] Occupational Safety and Health in the Wind Energy Sector, European Risk Observatory Report, page 46 European Agency for Safety and Health at Work

The O&M tasks specific to the WTGs are fundamentally same for offshore and onshore turbines; hence the hazards and risks inherent in those tasks are almost identical. However the OWF O&M activities have further safety risks in the following areas:

a. Weather and marine conditions (wind speed, wave height, temperatures, tides and currents)
b. Offshore transportation
c. Access to OSP
d. Access to Met-Mast and climbing Met-Mast
e. Access to offshore wind turbine
f. Working under the dry deck of offshore WTG foundation (confined space)
g. Diving into offshore WTG foundation
h. Underwater welding inspections and repairs by divers
i. Subsea cable inspection and repairs
j. Communication offshore in rescue request and emergency response scenario

In the following section risks inherent in wind farm operation and maintenance activities are addressed.

3.13.4.1. Access to WTG, OSP and Met-Mast

As addressed in the previous sections, access to WTGs, OSPs and Met-Mast is highly weather dependent activity as the wind speeds and the wave heights determine whether it is safe to travel to a WTG location and also safe to carry out boat landing considering the transfer vessel/boat capability. There various studies to determine most optimal and safest sea transfer and access to WTG, OSP or Met-Mast based on current vessel technology and projected vessel technology. As stated in the European Risk Observatory Report[161] work continues to be conducted to make available access and transfer systems that focus on:

a. rapid access to the wind farm on wider weather windows
b. transportation and transfers while avoiding sea sickness
c. provision of offshore accommodation
d. allowing for fully motion-compensated transfers to the turbines

3.13.4.2. Blade Inspections

Rotor blade inspections are one of the activities associated with high risk. As it is possible to carry out internal blade inspections in most of recent WTG types, such inspections take place. Although it is relatively safer to carry out blade inspections in a rotor blade, there are still risks associated with working in confined space as dust, vapors or harmful gases may be present in the confined space.

[161] Occupational Safety and Health in the Wind Energy Sector, European Risk Observatory Report, page 63, European Agency for Safety and Health at Work, 2013, https://osha.europa.eu/en/publications/reports/occupational-safety-and-health-in-the-wind-energy-sector

Therefore it is important to ensure sufficient ventilation in rotor blade before commencing inspection works. However, if inspectors believe that sufficient ventilation cannot be achieved, they should use suitable respiratory equipment to prevent inhalation of dust of harmful gases while carrying out inspections in a rotor blade.

External blade inspections are carried out using mainly rope access technique for offshore and new generation ONWFs. It is also possibly to carry out blade inspections using lifting devices that carry man-basket, which lifts the blade inspector to the blade height; this is a safer way of inspecting WTG rotor blades. Albeit much less reliable in most of the cases, there are other rotor blade inspection techniques such as thermography, visual inspections with binoculars, which are conducted from the ground, which presents no risk unless inspections ae carried out in freezing cold winter conditions when potential ice build-up on nacelle and rotor blades presents ice-throw risk. The ice throw risk is covered in this section 4.13.4.

Rotor blade inspections via rope access require each inspector to have valid certificate for working at heights and rope access. The fitness of an inspector also needs to be checked. The PPE such as fall protection equipment used for offshore WTG rotor blade inspections require special attention as there is greater wear and tear in PPE condition caused by saltwater corrosion in offshore environment. This necessitates frequent PPE maintenance with adequate PPE storage system that provides sealed protection to prevent saltwater corrosion.

3.13.4.3. Climbing and Working at Heights

As stated in the European Risk Observatory Report[162] one of the obvious hazards associated with working in wind farms both onshore and offshore is falls from heights. Inside the tower, climbing the fixed ladders inside the wind turbine to the nacelle can take its toll on inspectors or maintenance crew. These ladders require either a safety cage or a ladder safety device. Therefore a vertical fall arrest systems should span the entire height of the ladder and can include a stainless or galvanized steel cable or aluminum or stainless steel rail. The inspectors or maintenance crew must wear full-body harnesses connected to vertical fall arrest systems by shuttles or sleeves that follow them up and down the ladder. In the event of a worker falling, a brake in the shuttle will engage to arrest the fall.

When there is no lift or the lift is out of order, accessing the nacelle from the ground requires climbing rather tall vertical ladders (e.g., 80 m high). In fact inspectors or maintenance crew may have to climb up and down several times during a shift. This generates a high physical load on workers and may result in musculoskeletal disorders and physical exhaustion. Therefore, while all requisite safety equipment use is

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[162] Occupational Safety and Health in the Wind Energy Sector, European Risk Observatory Report, page 45, European Agency for Safety and Health at Work, 2013, https://osha.europa.eu/en/publications/reports/occupational-safety-and-health-in-the-wind-energy-sector

mandatory, a certain degree of cardiorespiratory fitness and strength in the limbs is necessary to ensure safe climbing and working at heights safely.[163]

3.13.4.4. Confined Space

As was briefly addressed before, it is very important to monitor the exposure of inspectors or workers to dust and harmful gases while working in confined spaces such as inside the rotor blade or under the airtight deck of offshore monopile foundation. Because confined spaces are not designed as regular work zones, they have limited access ways and egress, which present risks of oxygen depletion and injury caused by musculoskeletal disorders linked to awkward, static postures in a confined space. In the event of an incident in a confined space, it is difficult to conduct rescue as a result of access, internal space and egress limitations.

It is recommended in the European Risk Observatory Report that any maintenance technician (or inspector) entering a confined space should carry a portable gas monitor in his or her toolkit and must test air samples before entering the confined space, as these will warn against multiple threats posed by confined space entry, for example detecting toxic gases in parts per million levels and flammable gases at the lower explosive limit.[164]

3.13.4.5. Electromagnetic Interference

For operational WTGs there is a minuscule risk to inspectors and maintenance workers with regards electromagnetic production and interference. As WTGs contain electrical components producing power, they therefore also produce electromagnetic radiation but at a very low level and presents no greater risk to human health than most domestic appliances.[165]

3.13.4.6. Environmental Risks

In the operational phase of the wind farms a number of environmental risks exist. Although those risks are not significant in comparison to the environmental risks posed by conventional power plants or offshore oil and gas platforms, it is important to address them here as they fall within the scope of this study. The environmental risks can be categorized within the following areas:

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[163] Occupational Safety and Health in the Wind Energy Sector, European Risk Observatory Report, page 45, European Agency for Safety and Health at Work, 2013, https://osha.europa.eu/en/publications/reports/occupational-safety-and-health-in-the-wind-energy-sector

[164] Occupational Safety and Health in the Wind Energy Sector, European Risk Observatory Report, page 54 European Agency for Safety and Health at Work, 2013

[165] Draft PPS18: Renewable Energy Annex 1 Wind Energy Planning Issues: Electromagnetic Production and Interference, The Department of the Environment (Northern Ireland), UK

http://www.planningni.gov.uk/index/policy/policy_publications/planning_statements/pps18/pps18_annex1/pps18_annex1_wind/pps18_annex1_planning/pps18_annex1_electromagnetic.htm

- **Electromagnetic Production & Interference**: Scattering of electromagnetic signal mainly affects domestic TV and radio reception, and the general public may be concerned that a wind farm will interfere with these services. Experience has shown that when this occurs it is of a predictable nature and can generally be alleviated by the installation or modification of a local repeater station or cable connection.[166]

- **Low Frequency Noise (Infrasound):** According to the Department of the Environment (Northern Ireland), there is no evidence that ground transmitted low frequency noise from wind turbines is at a sufficient level to be harmful to human health[167]. However, there have been several complaints registered in Europe involving residents, living nearby onshore wind farms, who claimed to have experienced medical conditions including insomnia, raised cortisol levels, headaches, panic attacks, tachycardia, nausea, mood swings, palpitations, depression; however there is no scientific evidence that links the reported medical complications to the low frequency noise emitted by wind turbines. In Europe, there have been also complaints from various environmental groups claiming low frequency noise to be the root cause of many deaths among bats, which are protected species in most European countries.

- **Noise**: Well-designed wind farms should be located so that increases in ambient noise levels around noise-sensitive developments are kept to acceptable levels with relation to existing background noise. This will normally be achieved through good design of the turbines and through allowing sufficient distance between the turbines and any existing noise-sensitive development so that noise from the turbines will not normally be significant. Noise levels from turbines are generally low and, under most operating conditions, it is likely that turbine noise would be completely masked by wind-generated background noise.

Source / Activity	Indicative Noise Level dB(A)
Threshold of pain	140
Jet aircraft at 250m	105
Pneumatic drill at 7m	95
Truck at 30mph at 100m	65
Busy general office	60
Car at 40mph at 100m	55
Wind farm at 350m	35-45
Quiet bedroom	35
Rural night-time background	20-40
Threshold of hearing	0

[166] Draft PPS18: Renewable Energy Annex 1 Wind Energy Planning Issues: Electromagnetic Production and Interference, The Department of the Environment (Northern Ireland), UK

http://www.planningni.gov.uk/index/policy/policy_publications/planning_statements/pps18/pps18_annex1/pps18_annex1_wind/pps18_annex1_planning/pps18_annex1_electromagnetic.htm

[167] Draft PPS18: Renewable Energy Annex 1 Wind Energy Planning Issues: Low Frequency Noise (Infrasound), The Department of the Environment (Northern Ireland), UK

- Table 37 below shows the noise generated by wind turbines, compared with other every-day activities. There are two quite distinct types of noise source within a wind turbine. The mechanical noise produced by the gearbox, generator and other parts of the drive train; and the aerodynamic noise produced by the passage of the blades through the air. Since the early 1990s there has been a significant reduction in the mechanical noise generated by wind turbines and it is now usually less than, or of a similar level to, the aerodynamic noise. Aerodynamic noise from wind turbines is generally unobtrusive; it is broad-band in nature and in this respect is similar to, for example, the noise of wind in trees. Noise from the wind farm should be limited to 5 dB(A) above background for both day and night time, remembering that the background level of each period may be different.[168]

Source / Activity	Indicative Noise Level dB(A)
Threshold of pain	140
Jet aircraft at 250m	105
Pneumatic drill at 7m	95
Truck at 30mph at 100m	65
Busy general office	60
Car at 40mph at 100m	55
Wind farm at 350m	35-45
Quiet bedroom	35
Rural night-time background	20-40
Threshold of hearing	0

Table 37 – Noise Generated by WTGs in Comparison to other Noise Sources

- **Oil Spill Offshore**: Potential sources of oil spill offshore are the oil leak from nacelle and more significantly oil leak from maintenance vessels that are used during OWF maintenance practices. Oil spill from WTGs or vessels may be caused by the following accidents.
  1. Vessel collision with another vessel
  2. Vessels, planes or helicopters crashing into WTGs
  3. Collapsing WTG as a result of extreme meteorological events, seismic events (earthquakes, tremors, and tsunamis)
  4. Fire or explosion in nacelle
  5. Vandalism
  6. Mechanical failure
  7. Poor drive train maintenance practices

[168] Draft PPS18: Renewable Energy Annex 1 Wind Energy Planning Issues: Noise, The Department of the Environment (Northern Ireland), UK
http://www.planningni.gov.uk/index/policy/policy_publications/planning_statements/pps18/pps18_annex1/pps18_annex1_wind/pps18_annex1_planning/pps18_annex1_noise.htm

a. **Fire**: Smoke caused by WTG fire and debris scattered from the burning nacelle present risks to environment and wild life.

b. **Rotating Rotor Blades**: It is a known fact that rotating rotor blades have caused bird deaths in various OWF and ONWF sites. According to Spanish conservation charity SEO/Birdlife approximately between 110 and 330 birds are killed per turbine per year.[169] There are various reports around the world that WTGs have caused bird deaths including America's national bird, the bald eagle, UK's birds of prey, Australia's Tasmanian wedge-tailed eagle, etc.

c. **Shadow Flicker & Reflected Light**: Under certain combinations of geographical position and time of day, the sun may pass behind the rotors of a wind turbine and cast a shadow over neighboring properties. When the blades rotate, the shadow flicks on and off; the effect is known as 'shadow flicker'. It only occurs inside buildings where the flicker appears through a narrow window opening. A single window in a single building is likely to be affected for a few minutes at certain times of the day during short periods of the year. The likelihood of this occurring and the duration of such an effect depends upon:[170]

    i. The direction of the residence relative to the turbine(s),
    ii. The distance from the turbine(s),
    iii. The turbine hub-height and rotor diameter,
    iv. The time of year,
    v. The proportion of day-light hours in which the turbines operate,
    vi. The frequency of bright sunshine and cloudless skies (particularly at low elevations above the horizon) and,
    vii. The prevailing wind direction.
    viii. Soil contamination onshore: Incidents over the years showed that there is an environmental risk of soil contamination caused by oil leak from nacelle and from maintenance vehicles on ONWF sites.

While there is not much to be done about some of the environmental risks at the operational stage, some if the other risks such as soil contamination or oil spill offshore can be prevented by implementing

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[169] Guide for Assessing the Impact of Wind Farms on Birds and Bats, SEO/Birdlife, Spain, 2012 (Please note that the original text in the pdf file is in Spanish) http://www.seo.org/2012/01/12/seobirdlife-presenta-una-nueva-guia-para-la-evaluacion-del-impacto-de-parques-eolicos-en-aves-y-murcielagos/

[170] Draft PPS18: Renewable Energy, Annex 1 Wind Energy Planning Issues: Shadow Flicker and Reflected Light, The Department of the Environment (Northern Ireland), UK, 2014

http://www.planningni.gov.uk/index/policy/policy_publications/planning_statements/pps18/pps18_annex1/pps18_annex1_wind/pps18_annex1_planning/pps18_annex1_shadow.htm proper maintenance practices. Therefore based on the environmental risks identified above, it is recommended that BSEE reauire wind farm owner or operator to assign a third party inspection company to inspect the maintenance procedure and practices in accordance with the turbine manufacturer's maintenance manual to ensure that the wind farm operator is taking all possible precautions to minimize the environmental risks posed by wind farms, where possible.

Having addressed the main risks in OWF and ONWFs, the attention turns to risk based inspections in the following section.

3.13.4.7. Fire

Inspectors and other workers working on WTG, OSP or Met-Mast are exposed to fire risks. Fire can be caused by electrical spark or lightning strikes. Even though WTGs, OSPs and Met-Masts are equipped with lightning protection equipment - which must be designed to be compatible with the relevant distribution network, operator's distribution code and it must be compliant with any of their technical recommendations, and safety rules - they are still vulnerable to lightning strikes if the lightning protection system is not maintained resulting in malfunction of the system. It was reported in 2013 that fire in a nacelle killed two mechanics who attending inspection and maintenance works. According to the reporter, in a fire in a wind turbine on the Mary Dike in South Holland Ooltgensplaat two wind turbine mechanics, respectively 19 and 21 years old, deceased. One fell to his death from 80 meter high WTG and was found on the ground underneath the turbine, the other died from his burns and was found inside the charred remains of the turbine. At the time that the fire broke out, according to the police, there were four mechanics present in the wind turbine. Two mechanics managed to get to safety.[171]

3.13.4.8. High Voltage

One of the most prevailing risks when inspecting components of WTGs and OSPs is the electrocution from high voltage cables or equipment. As stated in the European Risk Observatory Report, with regard to electrical risks, working in nacelle may increase the risk of injury from sparking and electric shocks (which could lead to falls) or even electrocution, especially on some smaller, commercial-scale turbines that do not have brakes or shutoff mechanisms to prevent the turbine from accidentally being switched on during maintenance activities.

This risk is also prevalent during the transfer of personnel to offshore turbines and offshore substations for inspection and maintenance works as the offshore transfer - mainly by boat - will be dependent on the sea state. If the weather conditions deteriorate after an inspection team or maintenance team boarding on an offshore turbine or substation, they may get stranded until the sea state and the wind speed returns back to normal permitting transfer boat to return to pick up the team. While stranded on a WTG and OSP for a prolonged period, an inspection team will be staying in an operational turbine or

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[171] Lethal wind turbine accident in the Netherlands, Geenstijl, The Netherlands, 2013,

http://www.epaw.org/multimedia.php?lang=en&article=a19

platform with live high voltage cables and equipment, and therefore there is considerable risk of electrocution.

3.13.4.9. Ice Throw and Hypothermia

While high winds and waves have adverse effect on access to WTG, OSP or Met-Mast, extreme cold temperatures not only present hypothermia risk for the inspection and maintenance people but also cause ice build-up on blades, which can be thrown onto people taking part in inspection and maintenance activities offshore, which can be deadly. Ice throw/fall from the blades can be rather dangerous for maintenance crew as ice large ice pieces can be being thrown considerable distance by rotor blades, while large ice pieces may drop down from a switched-off WTG onto people beneath causing major injuries or fatalities. It is important to highlight that this risk is present not only at OWFs but also at onshore ones as well. The Wind Turbine Ice Throw Studies in Swiss Alps carried out by Cattin et al[172]. recorded that 121 ice fragments with a maximum length of more than 100cm and a weight of up to 18kg were thrown in distances of up to 92m from the wind turbine of an ONWF located on Gütsch mountain during the winters 2005/06 and 2006/07 in Switzerland. Figure 38 shows the distribution of the recorded fragments around the wind turbine. The study shows that most of the ice fragments come to land south of the wind turbine. This seems plausible as icing most likely occurs during situations with winds from the North whereas air from the South is often dried out by the Foehn effect and therefore only rarely causes any icing.[173]

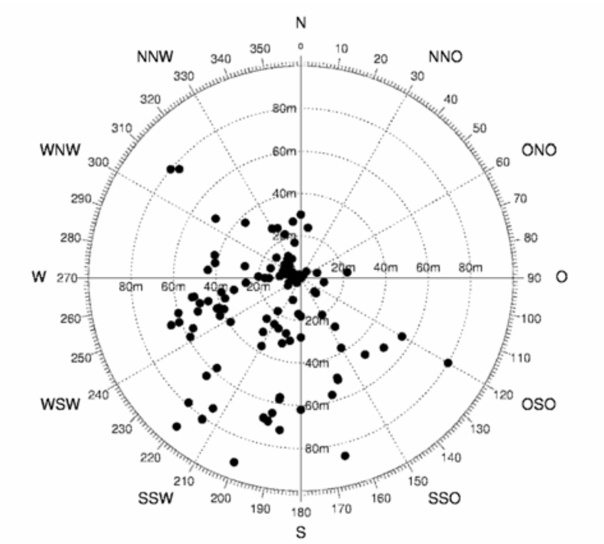

Figure 38 – Distribution of Ice Throw relative to Onshore Wind Turbine

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[172] The Wind Turbine Ice Throw Studies in Swiss Alps, René Cattin, Stefan Kunz, Alain Heimo, Gabriela Russi, Markus Russi, Michael Tiefgraber, White paper, Switzerland, 2009 http://www.meteotest.ch/cost727/media/paper_ewec2007_cattin_final.pdf

[173] The Wind Turbine Ice Throw Studies in Swiss Alps, René Cattin, Stefan Kunz, Alain Heimo, Gabriela Russi, Markus Russi, Michael Tiefgraber, White paper, Switzerland, 2009

The only way to reduce the risk to workers from ice pieces is to shut down the nearby WTGs when ice build-up on rotor blades is detected during the maintenance of a WTG. Sensors should be used to detect the ice build-up on blades.

3.13.4.10. Medical Fitness

The inspection works carried out at WTGs, OSPs and Met-Masts have specific safety hazards associated with various aspects of wind farm components, locations and working at heights. Therefore it is very important to ensure that every inspector is medically fit to carry out relevant inspection works. RenewableUK has produced a guideline on medical fitness to work. It is stated in the RenewableUK guidelines that working on offshore and onshore based wind turbines presents a number of physical and psychological challenges including:

a. **Exertion**: Climbing very tall vertical ladders (e.g. 80m) and potentially assisting with the rescue of an ill or injured colleague: When there is no lift or a failure of the lift, it is necessary to climb a long vertical ladder to access the nacelle. This requires a degree of cardio-respiratory fitness, strength in the limbs and the absence of musculoskeletal disease. Workers may have to climb several times a shift. They must also be able to manhandle a colleague in a confined space.

b. **Work Environment**: Hot working environment within the nacelle especially in summer. This presents a cardiovascular challenge.

c. **Confined Space**: Work in confined spaces e.g. on and under the generator, in the hub and internals of blades. Musculoskeletal flexibility is important for such work and the risk of a predictable collapse from a pre-existing medical condition must be minimized.

d. **Sea Survival Training (Offshore Turbines):** In addition to adequate mobility, the training requires a stable, robust mental state.

e. **Work in Cold and Adverse Conditions**: Except in summer, the sea transportation to offshore turbines and climbing vertical ladders (both external and internal) can expose workers to very low temperatures and sea spray. Onshore turbines are in exposed locations. Peripheral circulation and the condition of the skin must be assessed.

f. **Need for Agility**: When transferring from a vessel to the tower platform.

g. **Need for Good Hearing**: Communication is direct or using radio phones and can take place in a noisy environment (from mechanical tools or marine engines).

h. **Vision**: Good vision is required for a safe transfer from vessel to the tower platform and for awareness of physical hazards in the confined space of the nacelle.[174]

RenewableUK recommends all workers (including inspectors) to go through a health assessment at pre-employment, pre-placement and after any significant incident, injury or sickness absence. According to

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[174] Medical Fitness to Work – Wind Turbines, Guidelines for Near Offshore and Land based Projects, page 4, Renewable UK, London, 2013, http://www.renewableuk.com/en/publications/index.cfm/medical-fitness-to-work

the RenewableUK, periodic assessments should be undertaken every two years but more frequent assessments may be necessary in an individual case when there is a recommendation by an examining physician. The assessment should consist of a medical history questionnaire, clinical examination and a fitness assessment. This process should also ensure there is an effective procedure to validate the proof of identity (e.g., Passport or equivalent photo identification) of the individual concerned. The assessment may be undertaken by an occupational health nurse with reference to a suitable qualified and experienced doctor for specialist advice. Any employee who works (also carries out inspections) on wind turbines and who develops a medical condition that is a cause for concern should always seek occupational health advice before starting work. RenewableUK lists the following areas in health assessment:[175]

a. **Vision**: Visual acuity must be adequate for safe work and will normally be at least 6/9 in the better eye and 6/12 in the worse eye (with correction if worn). Where vision is impaired, an individual risk assessment should consider fitness for the task. Visual fields should be full in both eyes. Monocular vision is generally not acceptable, but where there is good adjustment to a long standing impairment, work on wind turbines may be permissible. Vision may be tested using Snellen's chart or Keystone apparatus. Spectacles (including prescription safety glasses) or contact lenses may be worn for correction.

b. **Hearing**: Hearing should be assessed using a practical test. Audiometry is normally not required but may be appropriate to determine baseline hearing levels if exposure to noise will be above the maximum noise level permitted in accordance with local regulations such as Action Level under the Control of Noise at Work Regulations 2005 in the UK. There must be no significant hearing impairment because the worker (inspector) must be able to hear voice communication and auditory warnings over a distance of 10 meters in an outdoor environment.

c. **Cardiovascular System**: Significant abnormalities of the cardiovascular system, including past heart attack (myocardial infarction), cardiac surgery or percutaneous coronary intervention, will require medical assessment by the doctor. Any conditions that may cause cardiac symptoms on exertion or sudden loss or impairment of consciousness are contraindications to working on offshore wind turbines. Poorly controlled blood pressure is also a bar as is any rhythm disturbance that causes or could cause impaired consciousness.

d. **Respiratory System**: Climbing vertical ladders within turbine towers requires good respiratory function. Severe chronic obstructive airways disease (COAD), asthma or previous lung surgery may impact on fitness and, therefore, require an assessment by a physician. Seasonal hay fever is not a contraindication. Respiratory function may be assessed by spirometry.

e. **Locomotor System**: A full range of movement of the back, neck and all four limbs is necessary for safety in climbing vertical ladders and working in confined spaces within the nacelle. Joint replacement may be a contraindication but individual assessment is required. There must be no

[175] Medical Fitness to Work – Wind Turbines, Guidelines for Near Offshore and Land based Projects, page 11, Renewable UK, London, 2013, http://www.renewableuk.com/en/publications/index.cfm/medical-fitness-to-work

significant muscular weakness in the finger flexors, elbow flexors, shoulder girdle muscles and knee extensors.

f. **Nervous System**: Any current or recent history of unexplained loss of consciousness, seizures, epilepsy or vertigo requires assessment. Where the condition is well controlled or unlikely to recur, the physician may consider the candidate acceptable for wind turbine work. Diseases causing muscle wasting or weakness, lack of co-ordination, severely impaired sensory modalities in the limbs or impaired mobility are contraindications if they would preclude the worker from climbing a very tall vertical ladder safely.

g. **Diabetes**: Well-controlled diabetic workers who do not suffer hypoglycemic attacks may be considered fit, but should have a full medical assessment by the Physician. Non-insulin dependent diabetics are generally suitable. However, poorly controlled or brittle insulin dependent diabetes is a contraindication. Thus, diabetic control must be considered at each health assessment.

h. **Mental State**: Mental illness involving psychosis or severe anxiety and depression is usually incompatible with work offshore. Persons with mild depression or short-term stress related illness and those being treated with psychotropic medication will need to be assessed carefully, taking into account issues such as impaired decision making and concentration and possible side effects of treatment on fitness.

i. **Drugs and Alcohol**: Workers' physical and mental fitness must not be impaired through the abuse of alcohol or prescribed or illicit substances as these are likely to have adverse effects on their judgment, concentration, memory and behavior. Medicines taken for seasickness can cause drowsiness and impair performance. If chronic alcohol or drug abuse is suspected, the worker must be suspended from work until advice has been obtained from the physician. Testing for drugs and alcohol at pre-placement health assessments (or in other situations such as unannounced or "for cause") is not essential but, in any case, should not be undertaken unless the protocol complies in full with the guidance provided by the Faculty of Occupational Medicine.

j. **Skin**: Sun sensitive skin conditions may preclude working out of doors. Other skin conditions may impair manual dexterity or limit the wearing of PPE. Some, such as psoriasis, are exacerbated by sea water. Thus, each case must be assessed individually. The rungs on ladders are square in cross section and place considerable pressure on the palms.

k. **Peripheral Circulation**: Impairment of the peripheral circulation (e.g. Raynaud's Disease or the vascular component of Hand Arm Vibration Syndrome) may be a contraindication because of the risks associated with work in cold conditions.

l. **Obesity**: Obesity is not a contraindication per se but agility and mobility must not be significantly impaired and anyone who is substantially overweight is likely to have difficulty achieving the required level of cardio-respiratory fitness.

m. **Physical Fitness to Climb**: Good cardio-respiratory physical fitness is necessary for the climbing aspect of work on wind turbine towers (in the event of lift failure or where there is no lift installed). Therefore, a test of cardiorespiratory fitness should be performed at each health assessment. To ensure consistency across the industry, it is recommended that estimated maximum oxygen uptake (VO2 max) is used as the measure of fitness. Various methods are available to estimate VO2 max indirectly such as the shuttle run or Chester Step Test. (Direct measurement requires costly sophisticated equipment and special expertise.) As normative data are available, it is recommended that estimated VO2 max in those working on wind turbines should be at least 35 mL/kg/min. Where this level of cardiorespiratory fitness is not achieved, the individual should be advised to undergo appropriate fitness training and, where appropriate, dieting to achieve a suitable weight. Re-testing should be arranged if the person believes they have achieved sufficient cardio-respiratory fitness.

n. **Other Health Concerns**: The above list of medical conditions and symptoms is not exhaustive. The physician conducting the examination may feel it necessary to consider other medical problems specific to the individual whose fitness is being assessed.

3.13.4.11. Rotating Equipment

Rotating equipment in nacelle presents risk for inspectors and other workers even when the wind turbine is switched off. There is at least one incident resulting in fatality in the UK. Incident happened when lanyard of a turbine inspector/maintenance crew member got trapped in rotating parts of the drive train; the inspector was pulled forward by the rotating equipment and then thrown against the nacelle wall. Unfortunately, the neck injury proved to be fatal on the spot. It was later on established that the one of the breaking system was not put on properly resulting in idle rotor blades starting to turn with the wind gathering speed while two inspectors/maintenance technicians were in the nacelle. Also, it is a procedure to remove lanyards when working around drive train of a nacelle to avoid lanyard being caught up in rotating equipment.

Working or carrying inspections around rotating equipment in nacelle requires specific safety procedures to be followed to eliminate risk of severe injuries, such as crushing fingers or hands, eye injuries, arm amputations and fatalities. It is also important to remember that the hot parts of nacelle may cause burns.

3.13.4.12. Underwater Inspections

During the operational phase of OWFs, it may be necessary to use divers to inspect subsea cables and foundation welds under water to monitor the condition of subsea cables and structural integrity of the foundations respectively when it is not possible or useful to carry out the inspections via ROVs. Diving, which is highly dependent on submarine conditions, is a dangerous and challenging activity that requires proper risk assessments to be carried out. Inspections via diving should only be carried out when the environmental conditions such as wave heights, currents, water temperature are conducive to safe diving by qualified and medically fit divers/inspectors after adequate risk assessment method statements are prepared for diving and inspection activities in advance.

3.13.5. Inspections based on Risks

Construction phase of wind farms is the riskiest phase in terms of safety in the full life cycle of a wind farm asset; it is because it involves working at remote locations and/or offshore, lifting/transporting/installing oversized and overweight components, installing offshore foundations, subsea cables, etc. While safety risks of construction activities cannot be ignored at ONWF projects, such risks are considerably higher at OWF projects. Therefore, risk based inspections will considerably benefit the reliability and the safety of OWF activities.

The study carried out by Wind Monitor looked into frequency of WTG component damage and related downtime. According to this study, the top three components that had the highest failure frequency rates were electrical system, electronic controls and sensors, but some of the least frequent WTG components failures namely generator, gearbox and drive train in that specific order, caused the highest downtime in power generation.

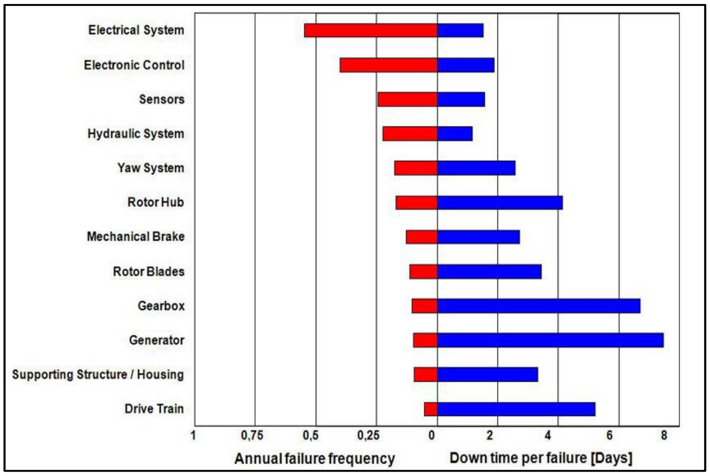

Figure 39 – Frequency of WTG Component Damage and Related Downtime[176]

It should be noted that Figure 39 only shows the frequency of WTG Component Damage and Related Downtime and it does not address structural integrity risk or OSP topside risks.

However the Wind Monitor study ranks the failure frequency rate, which provides information on which WTG components should be inspected based on mechanical failure rate.

The following WTG component failures that result in repair or replacement activities involve considerable safety risks in the process of repairing and replacing the damaged components:

a. Generator
b. Gearbox
c. Drive train
d. Rotor hub

[176] http://windmonitor.iwes.fraunhofer.de/windwebdad/www_reisi_page_new.show_page?page_nr=191&lang=eng

e. Rotor blades
f. Nacelle housing and main frame
g. Mechanical break
h. Yaw system

The other more frequent mechanical risks as shown in the Figure 39 and structural risks (which may be caused by coating failures, weld defects, grouted connection or foundation design error) that have been observed in OWF and ONWF are listed below:

a. Electrical component damages in OSP topside,
b. Structural damages in the tower section of a WTG
c. Structural damages in the transition piece of a WTG
d. Structural damages in the substructure of a WTG

Rangel-Ramírez and Sørensen published a white paper on RBI optimization of offshore wind turbines[177]. The paper considers the aspects of inspection and maintenance planning of fatigue prone details in jacket and tripod type of wind turbine support structures. Based on risk-based inspection planning methods for oil & gas installations, they presented a framework for optimal inspection and maintenance planning of offshore wind turbines. The paper takes into account the fatigue loading including the wind load and the wave load, as such loads affect the structural integrity and safety of the foundations/WTGs. Rangel-Ramírez and Sørensen have used the Bayesian decision theory in assessing the probability of structural failure in offshore wind turbines - because the time varying fatigue degradation in offshore structures is a highly uncertain process – when determining the risk based inspection requirements for structural integrity. Although this study predominantly focuses on risk on structural integrity and cost, it also indirectly provides relevant information on safety aspect of the risk based inspection requirements.

It is recommended for BSEE to ensure that OWF owners implement structural integrity condition monitoring campaigns by installing sensors (strain gauges) on the support structures, nacelle main frames, and rotor blades to collect data in order to determine an appropriate risk based inspection program for an OWF.

It is recommended for BSEE to ensure that all relevant technical inspections and document reviews of maintenance practices on mechanical and structural components are carried out whether by wind farm operators or by third party inspection companies

It is recommended for BSEE to ensure that a number of additional periodic safety inspections are carried out by wind farm operators/owners or by third party companies. The purpose of these safety inspections is to ensure safe working environment for people involved in OWF and ONWFs and also to safeguard the safety of public and environment.

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[177] RBI Optimization of Offshore Wind Turbines, José G. Rangel-Ramírez & John D. Sørensen , Department of Civil Engineering, Aalborg University, Denmark, 2008 http://vbn.aau.dk/files/16623693/RBI_Optimization_of_Offshore_Wind_Turbines

Therefore in addition to the technical inspections, it is recommended for BSEE to ensure that the wind farm operators/owners not only comply with the statutory inspection requirements and but also make sure that the following safety inspections are carried out:

a. **Ladders:** Internal and external ladders must be inspected in regular intervals by competent person or third party inspectors. The inspection should focus on the ladder's structural integrity and the surface upon which a ladder rests; the surface should be stable, firm, of sufficient strength and of suitable composition to support the ladder safely, so that its rungs or steps remain horizontal with any loading intended to be placed on it.

b. **Lifting Equipment and Tools:** Statutory inspections need to be carried out for lifting equipment and tools in accordance with the regulatory requirements. Inspections should focus on adequateness and accuracy of the lifting work procedure (safe working procedures must be drawn up for each lift installation), risk assessment, which must be made to identify hazards associated with work on each lift installation, previous lifting activity records and training certificates of personnel who use lifting equipment.

c. **Noise:** For the OWF construction projects, a noise risk assessment should be carried out at the beginning of the piling of foundations offshore. When exposed to harmful noise that are too loud or loud sounds that last a long time, sensitive structures in the inner ear can be damaged, causing hearing loss. Table 38 shows the lower and upper noise exposure values, noise exposure limits and where appropriate, action required to be taken to reduce that exposure in the UK. Noise can be detrimental not only to workers involved in installation of offshore foundations, but also to residents living at nearby shore locations. The inspection should focus on procedure and implementation of use of PPE for noise protection.

	Daily/Weekly Exposure	Peak Exposure dB(C)	Action to be taken
Lower Exposures Action Values	80	135	Workers must be provided with personal hearing protection, complying with the requirements of the Merchant Shipping and fishing Vessels personal Protective Equipment) Regulations 1999.
Upper Exposure Action Values	85	137	Workers are required to use personal hearing protection complying with the requirements of the Merchant Shipping and Fishing Vessels (Personal Protective Equipment) Regulations 1999 Workers are entitled to have their hearing examined by a doctor, or a suitably qualified person under the super vision of a doctor. Employers must establish and implement a programme of measures to reduce the exposure to noise
Exposure Limit Values	87	140	This limit **must not be exceeded.**

Table 38 – Lower and Upper Noise Exposure Values[178]

[178] Code of Safe Working Practices for Merchant Seamen, page 467, Maritime and Coastguard Agency, the Department for Transport, UK

d. **Offshore Transportation and Boat Landing:** Periodic inspections/audits need to be carried out to ensure that transportation method and boat landing procedure are adequate for the OWF site conditions and those they are implemented correctly. The following four different WTG accesses can be used taking into consideration that access is not always possible because of offshore weather conditions: (a) direct landing by use of vessel, (b) boat landing with motion compensation, (c) crane hoist and (d) helicopter (more suitable for OSPs rather than WTGs).

e. **Safety Equipment and PPE:** Safety equipment must be inspected after it has been installed, and before being put into use for other activities later in the construction or subsequent phases of OWF and ONWFs. PPE must be regular inspected by the users and the operator/owner of the wind farm regularly to ensure that PPE is fit for purpose and also used properly. The relevant PPE procedures such as "buddy checks" of each other's PPE prior to commencement of a task can help to fulfil this duty should also be reviewed for their validity and accuracy.

f. **Safety Management System:** Periodic inspections should be carried out to assess the validity and adequacy of the safety management system including safety organization, safety procedures, communication of safety plan and procedures to wind farm construction team or O&M team or contractor. Safety inspections should include the review of work instructions, RAMS, safety training records, medical fitness records and competency records.

g. **Unexploded Ordnance (UXO) Risk:** Particularly for the OWFs it is very important to get specialist companies to carry out UXO surveillance ahead of offshore construction activities to determine the UXO threat and carry out necessary risk assessments.

3.14. Condition Monitoring

This section addresses whether condition monitoring (CM) is being used and if so, how. Where such practice is not in place recommendations are made on how to implement condition monitoring in the overall inspection scheme.

3.14.1. General

Condition monitoring (CM) refers to the sensing and reporting of physical parameters of machinery with the intention of understanding the current and future health of the devices under scrutiny. CM is normally refers to the use of this protocol on rotating machinery. The sensing of physical parameters on non-rotating machinery is covered in the section 2.15, Real-Time Monitoring Systems. CM utilizes sensors which measures physical parameters such as vibration, temperature, etc. of these devices under operating conditions. This data is then analyzed, and a signal sent upstream if preset thresholds are crossed. Through this process, it is possible to not only signal a faulty device, but also to predict that the device is nearing to a catastrophic failure before the event.

While long used to monitor the WTG performance, in the wind turbine industry, condition monitoring of WTG structures is a relatively new feature, compared to other large-scaled, land-based, high capital rotary machinery applications. However, factors such as capital investment combined with difficulty of access, have driven CM to accelerated adoption in the OWF and ONWF designs.

While most current implementations for CM in WT's are focused on the major rotary components, CM evolves, it could begin expanding into secondary components, such as yaw servomotors, pitch servomotors, etc.

There are three main areas in which structural integrity monitoring can be applied to an onshore wind turbine which are the rotor (including the blades), the tower and the foundations. Each structural component presents different structural problems, failure modes and failure rates.

For onshore WTGs, a typical structural integrity monitoring for tower and foundations involves a technician visiting each turbine on a regular basis to record visible movement using a surveying theodolite. Inspections are increased when there is a significant change in the magnitude of vertical movement. This method of inspection is time consuming and costly as well as being unavailable for extended periods during winter conditions. When this type of inspections is carried out, the technician on site requests the operating station to stop the turbine temporarily. The greatest movement indicating structural integrity issues can be seen during shutdown when WTG is operating at or above its rated wind speed. While this method has been used successfully there are some key draw-backs, which make it ineffective and inefficient including site access difficulties during winter, the lack of ongoing monitoring and the use of staff resources[179].

An increasing number of OWF owners have started to use relative new sensing solution to monitor the condition of large-scale multi-megawatt wind turbine foundations. This system has been designed for 'embedded can' style foundations. The only data currently gathered on the tower movement is based on accelerometer readings from the nacelle. These data do not give specific details on the foundations. It is unknown how widespread the problems are due a lack of published data relating to wind turbine foundations. The authors propose an inexpensive monitoring solution that actively monitors the structural integrity of the turbine and reports its status to a remote technical center (RTC) or head office. Inspection of the displacement data and trending can enable technical personnel to improve the understanding of failures and allow the development of appropriate techniques to resolve them[180].

The direct data from the CM systems will be large and incomprehensible in its raw form. From an inspection basis, BSEE will likely only be interested in analysis reports which are distilled from the CM data flow. Though, the raw data could be of a value in a forensic manner in the case of analyzing a catastrophic event, especially to better understand failure modes of critical components in the future. In this way, CM is positioned to evolve it usefulness as this learnt behavior get implemented upstream to installed CM systems in similar WT's.

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[179] M. Currie, M. Saafi, C. Tachtatzis, F. Quail, Structural Health Monitoring for Wind Turbine Foundations, Institution of Civil Engineers, 2012, Glasgow, http://www.academia.edu/6596292/Structural_health_monitoring_for_wind_turbine_foundations

[180] M. Currie, M. Saafi, C. Tachtatzis, F. Quail, Structural Health Monitoring for Wind Turbine Foundations, Institution of Civil Engineers, 2012, Glasgow, http://www.academia.edu/6596292/Structural_health_monitoring_for_wind_turbine_foundations

3.14.2. Structural Monitoring

The study carried out by M. Currie et al. shows that real-time structural integrity monitoring on onshore WTG components including rotor, rotor blade, tower and foundation offers an alternative solution to conducting on-site inspections (see Figure 40).

Technique	Measurement principle	Advantage	Disadvantage	Relative cost
Infrared	Time of flight of infrared signal	Lowest cost option	High risk of target or sensor being covered by residues	Low <£50
LVDT	Voltage differential	High accuracy and easy installation; protected from elements	Higher cost	High £200–400
String potentiometer	Electrically variable with displacement	Simple installation	Moving parts at risk of getting clogged	High £200–400
Hall effect	Electrically variable with magnetic signal	Simple to install and results not compromised by dirt	Electromagnetic radiation from the high-voltage cable may heavily interfere	Medium £50–200

Figure 40 – Alternative Real-Time Structural Integrity Monitoring Systems

For offshore WTGs, remote structural condition monitoring systems are utilized for cost effective and proactive monitoring particularly for the structural integrity of tower, TP and the foundation. This technique can also be used for the structural integrity of foundations used for OSPs and Met-Masts. The remote structural condition monitoring systems requires strain gauges (sensors) to be installed near two circumferential welds (upper and lower level) at the transition piece (TP) level and also sub-sea strain gauges to be installed near two circumferential weld (upper level and near mudline) under water at the monopile level at the manufacturing stage; all sensors can be connected to a data logger, which can be positioned in the TP on the dry deck connected to the control room onshore via fiber optic cable for regular condition monitoring. This practice will not only reduce the cost of inspections drastically, it will also enable reliable structural condition monitoring on a regular basis while mitigating relevant safety hazards in the process. It should be remembered that underwater inspections carried out by divers present major safety risks, hence utilizing such online structural condition monitoring for the foundations and transition pieces will eliminate the safety risks involved in diving practices.

3.14.3. Standards

CM is required for offshore wind turbines type certified according to Germanischer Lloyd's Guideline for the Certification of Offshore Wind Turbines Edition 2012[181]. Paragraph 13.1 (2) of this guideline states:

A certified Condition Monitoring System (CMS) according to the latest edition of GL's "Guideline for the Certification of Condition Monitoring Systems" for Wind Turbines is required for offshore wind turbines.

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[181] Guideline for the Certification of Offshore Wind Turbines Edition 2012, http://www.gl-group.com/en/certification/renewables/CertificationGuidelines.php

The following data must be continuously monitored according to the GL Guideline:

a. wind direction
b. outside temperature
c. nacelle temperature
d. gearbox, generator, and main bearing temperature
e. generator winding temperature
f. oil temperatures and pressure (e.g. hydraulic oil, gear oil)
g. control system messages
h. blade vibration
i. optionally oil cleanliness, particle counting

Section 13.1 of this standard further states:

(4) Additional information about the status of the offshore wind turbine and its components can be given by using camera(s) and microphone(s) or other suitable methods at characteristic places of the offshore wind turbine.

(5) The complete CMS incl. sensors, cables etc. shall be adequate for use under offshore conditions and shall be so designed that its functions will not be disturbed.

(6) Special care shall be taken when applying vibration sensors to a component. Gluing is not acceptable. Sensors that can be misused (e.g. as a foot rest) shall be protected against misuse.

(7) Long periods of grid unavailability might occur offshore. Measures have to be taken to save data in such cases.

Germanischer Lloyd's Guideline for the Certification of Condition Monitoring Systems for Wind Turbines Edition 2013[182] provides further detailed guidance for the design and installation of the CM as well as the analysis and storage of the data. The scope of this guideline is primarily oriented to the rotor and drivetrain. This is largely due to the combined economic benefits of reducing on-site visits and reducing catastrophic failures, thus increasing reliability in general. These benefits outweigh the additional upfront costs and O&M burden from the implementation.

DNV-RP-J301 Subsea Power Cables in Shallow Water Renewable Energy Applications[183] recommends CM of offshore cables. This Recommended practice states:

[182] Guideline for the Certification of Condition Monitoring Systems for Wind Turbines Edition 2013, http://www.gl-group.com/en/certification/renewables/CertificationGuidelines.php

[183] Recommended Practice DNV-RP-J301 Subsea Power Cables in Shallow Water Renewable Energy Applications, http://exchange.dnv.com/publishing/codes/docs/2014-02/RP-J301.pdf

Objectives for (continuous) monitoring are to record the status of the cable system, to detect changes in operating conditions and to take mitigation actions such as restricting operational parameters (e.g. electrical current, temperature). Conditions of the cable which are monitored may include:

a. electrical - voltage, current, power
b. thermal - temperature
c. mechanical - tension, bending, vibration.

CM is also expected to be incorporated into additional standards in the near future as mandatory inclusion, such as IEC 61400-3 Wind turbines –Part 3: Design requirements for offshore wind turbines and DNV-OS-J102 Design and Manufacture of Wind Turbine Blades.

3.15. Real-Time Monitoring Systems

This section addresses how the control systems and real-time monitoring (RTM) technologies are being used to monitor wind farms or turbines and how these systems are inspected. Sensing of the active rotary machinery is covered in section 2.14 Condition Monitoring.

3.15.1. Control and Safety System

The control and safety system of the wind turbine is responsible for the continuous monitoring, automatic adjustment, and reporting of the wind turbine operational state, performance, and any faults or warnings. The main functions of the wind turbine controller include yawing, braking, operational mode control, pitch control, generator torque control, and overall system fault and status reporting.

The control and safety system logs real time data in each turbine a short term basis (the data is typically overwritten in a loop after several days). The real time data is also transmitted through the SCADA system for remote monitoring and long term storage off-site. The control system also interfaces with the condition monitoring system (CMS) so that structural load or vibration events recorded by the CMS can be correlated with operational or environmental conditions recorded by the controller.

In case operational parameters are exceeded and the control system does not react as designed, the wind turbine safety system can initiate a shutdown independently. The safety system is designed to be redundant and separate from the control system to avoid common cause failures of safety shut-down functions. The protection functions which are used as monitoring devices for the safety system are:

a. Over-speed and over-power protection
b. Shock and Vibration protection
c. Excessive Yaw / Cable Twist
d. Pitch System Malfunction
e. Controller Malfunction
f. Emergency stop buttons

3.15.2. SCADA

Owners and operators employ Supervisory Control and Data Acquisition (SCADA) systems to monitor and control wind farms. In a typical state-of-the-art system, each turbine of a wind farm is connected to a park network, which is accessible on site by service technicians, and remotely by owners, engineers, or third parties. Access to the network is restricted to authorized personnel, and different levels of access are employed for different purposes, for example status and data view only, start-stop control, or change control parameters. Remote control of the turbine (i.e. start, stop, manual yaw) can always be prevented by personnel working in the turbine.

Each wind turbine is configured to operate autonomously and automatically, so continuous remote control and monitoring is not required for operation, however it is beneficial in reducing down time due to faults and improving maintenance management. Operators with large fleets may have centralized monitoring centers where the entire fleet can be monitored 24-7. Owners with small farms may only periodically monitor the farm, or may subcontract the monitoring to a third party such as a maintenance contractor.

The SCADA system can also be set up to manually or automatically download the data recorded by the wind turbine control system for analysis and/or long term storage. Data resolution and storage space required must be balanced depending on the purpose of the data. The highest continuous data resolution is on the order of one second, while 10 minute or hour average data storage is common. For the purposes of fault analysis, high resolution (on the order of 10ms) data can be recorded for a short time before and during a fault.

The main types of data of interest for owners, operators, and engineers undertaking failure or performance analysis would include:

a. Wind speed and direction
b. Electrical power output
c. 3-phase current, voltage, power factor
d. Rotor and Generator RPM
e. Rotor and generator torque
f. Nacelle position and yaw error
g. Blade pitch positions
h. Current and historical status and fault messages
i. Status messages from the CMS
j. Ongoing availability and power production totals
k. Ongoing power curve calculation

Long term storage of continuous operational data, environmental conditions, and fault history is extremely valuable for analysis of wind farm performance and reliability, root cause analysis of serial component failures, and investigation of catastrophic failures. SCADA software solutions are available from wind turbine suppliers, as well as multiple third party companies offering platforms which work with any turbine type.

3.16. Inspections at Commissioning and De-Commissioning

This section addresses what the key milestones are during commissioning and decommissioning of wind turbines that should trigger an inspection.

Inspections at commissioning of OWFs are currently carried out by various entities, for example the wind turbine supplier, the substructure supplier, the project owner's representative, the CVA or project certification body, insurance and lenders representatives, the grid operator, and local or national authorities having jurisdiction over the project.

Decommissioning inspections are often carried out by third party inspectors employed by the project owner, usually with a view to assessment for continued operation or repowering on the existing substructures.

3.16.1. Commissioning

Offshore wind turbines, substations, and cables are typically commissioned by the suppliers of the equipment, and commissioning and is witnessed by the project owner's representative. For OWF projects in jurisdictions requiring project certification, such as Germany, commissioning witnessing or additional testing is performed by the certification body. For OWF projects in jurisdictions requiring a CVA, such as the US, commissioning witnessing or additional testing is performed by the CVA. In jurisdictions requiring neither certification nor verification, inspection or commissioning witnessing by an Independent Verification Body is at the option of the project owner.

Specific devices critical to personnel safety such as lifting equipment and fire protection equipment (refer to section 1) require additional inspection by the authority having jurisdiction prior to the first operation of the wind farm. Lenders and insurers may require additional independent inspections prior to operation, and the grid operator will require tests at commissioning of the grid connection equipment.

3.16.2. Decommissioning

At the end of the design life of the wind farm the project owner will typically order a third party assessment of the assets to determine if there is remaining operational life. The third party performs a thorough inspection of the wind farm, and may perform new load, strength, and fatigue life calculations based on environmental, load, and performance measurements taken during the operation of the wind farm. This is undertaken to evaluate whether repowering or life extension are feasible alternatives for the OWF. Whether or not the life of the WT is extended, there will come a time when the WT is no longer viable. This can happen due to a failure that is deemed inappropriate to repair, or that the risk of a catastrophic failure is too great.

A decommissioning plan will have been created at the project outset, with suitable financial instruments to secure a viable decommissioning. This plan will need to be reviewed for the reality of current events and situation surrounding the current state of the OWF as well as available resources for the decommissioning work.

It would be easy to say that the decommissioning plan will be just the commissioning plan in reverse, this is not the case. Certain elements, such as undersea cables, may not be removed depending on each case. Also, removal of bolts and hardware which has been in a marine environment for twenty or more years will likely be more difficult. The foundation for example may be grouted to pilings, which may require that they be cut off via welding at, near or below the mudline. All of these steps have to be done in a safe manner. Oversight of the process is vital to ensure a safe and effective removal of the WT while ensuring a safe working environment and minimal impact on the environment.

3.16.3. Standards

3.16.3.1. ABS Guides

The ABS Guideline for Certification of Offshore Wind Farms[184] contains the following guidance on inspections to be carried out at **installation**:

ABSG will conduct installation surveys of offshore wind turbines and, optionally, the Other Installations during their load-out at the pier and offshore installation at the site, to:

a. verify that the items covered by the Project Certification are installed in compliance with the requirements of the approved design documentation;
b. witness relevant load-out and installation operations; and
c. inspect for damages and overstresses that may have occurred during the installation.

Upon satisfactory completion of the certification module as required in this Subsection, a Statement of Compliance for installation surveys of offshore wind turbines and the specified Other Installations of the offshore wind farm may be issued.

Installation Survey Requirements

Prior to the first load-out and installation operations, load-out and installation procedures and checklists should be submitted for review and approval.

Refer to 1-2/3.21 or 1-2/5.15 of the ABS BOWTI Guide for the installation survey requirements relevant to the Bottom-founded Offshore Wind Turbines.

Refer to 11-1/5.1 of the ABS FOWTI Guide for the installation survey requirements relevant to the

Floating Offshore Wind Turbines. Additional survey requirements for the inclining test or the equivalent weighing procedure are specified in 9-2/7 of the ABS FOWTI Guide.

The installation of the RNA and equipment and systems supporting operations of the RNA and hook-up of the electrical cables should be witnessed by the attending Surveyor.

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[184] Guideline for Certification of Offshore Wind Farms

Deviations from approved design documentation or any incidents such as damage or overstress to the RNA and the supporting structures during the installation may require re-submittal of additional documentation to provide an assessment of the significance of deviation and any necessary remedial actions to be taken.

As a minimum, installation surveys should be conducted for the load-out and installation of the first offshore wind turbine per each type in the offshore wind farm. Depending on the installation survey results as well as the number and type of offshore wind turbines in the farm, installations surveys may be extended to more offshore wind turbines to the satisfaction of the attending Surveyor.

Where the Other Installations of the offshore wind farm are included in the Project Certification, relevant installation survey requirements as specified in the ABS Offshore Installations Rules, Part 1 Section 2 or the ABS FPI Rules, Part 7 Chapter 1 should be satisfied. For those installations not covered by ABS rules or guides, recognized industry standards may be applied.

The ABS Guideline for Certification of Offshore Wind Farms contains the following guidance on inspections to be carried out at **commissioning**:

ABSG will conduct commissioning surveys to verify that the installed offshore wind turbines and, optionally, the Other Installations are commissioned in accordance with the manufacturer's requirements and instructions and in compliance with relevant design requirements of the approved designs. Commissioning surveys involve documentation reviews and on-site surveys.

Upon satisfactory completion of the certification module as required in this Subsection, a Statement of Compliance for commissioning surveys of offshore wind turbines and the specified Other Installations may be issued.

Commissioning Survey Requirements

Prior to the commissioning of the first offshore wind turbine or the Other Installations covered by the Project Certification of the offshore wind farm, the commissioning procedures and checklists should be submitted for review and approval. The manufacturer's instructions should include all necessary procedures for testing the installed offshore wind turbine or the relevant Other Installations to confirm proper, safe and functional operation of equipment, systems and controls.

The commissioning is to be carried out in accordance with the approved step-by-step commissioning procedures. The Surveyor is to be permitted sufficient access to verify that the procedures are satisfactorily accomplished.

Before the start of commissioning operations, the attending Surveyor will verify:

a. the safety of personnel by checking operational readiness of all lifesaving, fire detection and firefighting equipment, and unobstructed escape routes;
b. the establishment of communication procedures; and
c. the emergency procedures dealing with contingencies.

During commissioning surveys for offshore wind turbines, the attending Surveyor is to observe the offshore wind turbine operating under various capacities and conditions. As a minimum, the following procedures and tests should be witnessed by the attending Surveyor:

a. Safe start-up
b. Safe shutdown
c. Safe emergency shutdown
d. Safe shutdown from overspeed (or representative simulations)
e. Function test of protection systems
f. Check of the control system settings
g. Function test of automatic operations
h. Function test of the yaw system, if applicable

For the Floating Offshore Wind Turbines, additional commissioning surveys are required for the applicable marine systems and associated equipment and machinery, safety systems and associated equipment, and lifesaving appliances and machinery of the Floating Offshore Wind Turbines. Approved operations including emergency procedures should be verified to the extent deemed necessary by the attending Surveyor.

The overall performance of the RNA is to be verified for compliance with the design parameters of the approved designs. Records of all these verifications as well as the post-commissioning actions taken in accordance with the manufacturer's instructions should be included in the final commissioning reports and submitted to ABSG for review.

As a minimum, commissioning surveys should be conducted for one (1) offshore wind turbine per each type. Where there are more than fifty (50) offshore wind turbines of the same type, commissioning surveys should be conducted for at least one additional offshore wind turbine per every fifty (50) of the same type.

The selection of offshore wind turbines for commissioning surveys should reflect having Surveys at the start and end of commissioning periods.

During commissioning surveys for the Other Installations, the attending Surveyor is to observe the operations of main equipment, systems and controls under various capacities and conditions. As a minimum, the following procedures and tests should be witnessed by the attending Surveyor:

a. Safe start-up
b. Safe shutdown
c. Function test of safety systems
d. Check of the control system settings
e. Function test of automatic operations

Records of the post-commissioning actions taken in accordance with the manufacturer's instructions should be included in the final commissioning reports and submitted to ABSG for review.

Project Characteristics Measurements

On request of the Owner, ABSG will verify that the optional measurements of performance-related characteristics of a specific wind turbine or an offshore wind farm at an offshore site are performed in accordance with approved standards and procedures.

Refer to IEC 61400-22, Section 9.11 for the certification requirements for project characteristics measurements for one or more of the following items:

a. Grid connection compatibility according to grid codes
b. Verification of power performance
c. Verification of acoustic noise emission

Measurement methodologies and procedures should be submitted for review and approval prior to performing the measurement. Witnessing of the measurements by the Surveyor may be required depending on the completeness of test laboratory's quality management system.

Upon satisfactory completion of the certification module as required in this Subsection, a Statement of Compliance for project characteristics measurements of specified items for the offshore wind turbine or the offshore wind farm may be issued.

3.16.3.2. IEC International Standards

The IEC Standard 61400-3 International Standard Wind turbines – Part 3: Design requirements for offshore wind turbines[185] contains the following requirements for tests at commissioning:

The manufacturer's instructions shall include the procedures for testing of the offshore wind turbine after installation, to confirm proper, safe and functional operation of all devices, controls and apparatus. These shall include, but not be limited to

a. safe start-up;
b. safe shutdown;
c. safe emergency shutdown;
d. safe shutdown from overspeed or representative simulation thereof;
e. function test of protection system.

At the completion of installation, and following operation for the manufacturer recommended running in period, the specific actions that may be required by the manufacturer shall be completed.

These can include, but are not limited to preloading of fasteners, changing of lubrication fluids, checking other components for proper setting and operation and proper adjustment of control parameters.

[185] IEC 61400-3 International Standard Wind turbines – Part 3: Design requirements for offshore wind turbines http://webstore.iec.ch/

The IEC Standard *61400-22 International Standard Wind turbines – Part 22: Conformity testing and certification*[186] gives the following requirements for commissioning surveillance by the certification body:

The purpose of commissioning surveillance is to verify that the wind turbines installed in a specific project at a specific site are commissioned in conformity with the relevant manuals included in the design documentation.

The certification body shall evaluate whether the commissioning of the wind turbine(s) is in conformance with the instructions supplied by the manufacturer in accordance with relevant parts of the IEC 61400 series. Other tests to be performed during commissioning in addition to tests in accordance with the general instructions may be agreed with the manufacturer.

This evaluation requires examination of commissioning records. In addition, the certification body shall witness the commissioning of at least one wind turbine and additionally at least one wind turbine per every 50 turbines in the project.

The certification body shall as a minimum verify that:

a. the commissioning instructions supplied by the manufacturer are adequate;
b. the instructions supplied by the manufacturer are followed during commissioning; and
c. the final commissioning reports are complete.

Verification and surveillance activities shall be concluded with reports that describe the activities carried out.

3.16.3.3. GL Guidelines

The Germanischer Lloyd Guideline for the Continued Operation of Wind Turbines Edition 2009[187] contains guidance for assessment of wind farm assets for continued operation at the end of the design lifetime, including inspection and analysis of lifetime load conditions (see Figure 41).

[186] 61400-22 International Standard Wind turbines – Part 22: Conformity testing and certification http://webstore.iec.ch/

[187] Guideline for the Continued Operation of Wind Turbines Edition 2009 http://www.gl-group.com/en/certification/renewables/CertificationGuidelines.php

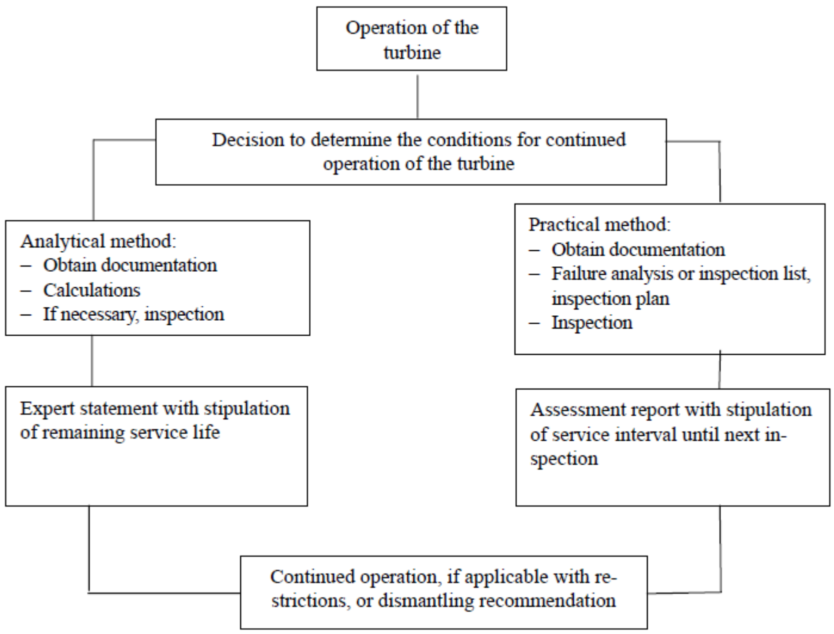

Figure 41 - Flowchart for decision to recommend continued operation or decommissioning

3.16.3.4. DNV Recommended Practice

The DNV Offshore Standard *DNV-OS-J101 Design of Offshore Wind Turbine Structures*[188] is applicable to substructures designed for wind farms, but not to the wind turbines installed on the substructures. The standard gives guidance on installation survey requirements:

A Marine Warranty Survey (MWS) may be required by the insurance company in order to effect an insurance for temporary phases such as sea transport and installation.

The purpose of an MWS is to ensure that the marine operations are performed within defined risk levels. These risk levels should be tolerable to marine insurance and also to the industry, as well as to the national and international Regulatory Bodies.

An MWS should be carried out in accordance with an internationally recognized standard. The DNV 'Rules for Planning and Execution of Marine Operations' represents a standard which is widely recognized by both insurance, finance and marine industries.

The DNV recommended practice *DNV-RP-J301 Subsea Power Cables in Shallow Water Renewable Energy Applications*[189] contains the guidance on assessment of subsea cables for continued operation at the end of the design lifetime (see Figure 42).

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[188] Offshore Standard DNV-OS-J101 Design of Offshore Wind Turbine Structures http://www.gl-group.com/pdf/DNV-OS-J101_2014-05.pdf

[189] DNV-RP-J301 Subsea Power Cables in Shallow Water Renewable Energy Applications http://exchange.dnv.com/publishing/codes/docs/2014-02/RP-J301.pdf

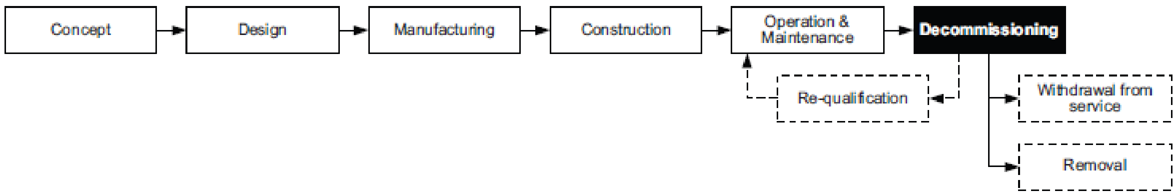

Figure 42 – Flow chart of subsea cable life cycle including decommissioning

The recommended practice gives the following guidance on the decision process to remove the cables or leave them in place after the end of service:

Cable decommissioning shall be planned and prepared. Decommissioning evaluation, including review of the abandonment/removal options, should include the following aspects:

a. relevant national and international regulations
b. natural environment (benefits of not disturbing the seabed, possible pollution, future effects)
c. obstruction for surface navigation, also in comparison to existing installations, wrecks and debris
d. impact on fishing activities
e. mobility of sediments and change of the cable presenting a hazard over time
f. future management of an out-of-service cable system
g. technical feasibility and socio-economic benefits of cable removal.

3.16.3.5. API Standards

The API RP-2A - Planning, Designing, and Construction Fixed Offshore Platforms – Working Stress Design[190] is a crucial standard in the offshore oil and gas industry. Chapter 18 is specifically dedicated to reuse of offshore structures. It should be noted though that this standard utilizes the Working Stress Design (WSD) engineering methodology which is common in the oil and gas industry. Offshore wind generally utilizes the Load Resistance Factor Design engineering methodology.

3.17. Inspection Requirements for R&D Projects

In this section we address whether the inspection requirements and procedures for an offshore wind energy research project should differ from those for a commercial project.

3.17.1. R&D organizations

There are several organizations within the US committed to R&D and advancing the science of wind energy development. These include but are not limited to the following:

1) Government-based

   a) National Renewable Energy Laboratories (NREL)

[190] API RP-2A, Chapter 16

NREL, in close partnership with SNL and the DOE, is directly tasked with improving wind energy science. They have a top of the line testing facility in Boulder, CO plus provide analysis on all sectors of the wind industry.

b) Sandia National Labs (SNL)

SNL has a dedicated staff of top researchers tasked with improving the reliability and economics of all facets of the wind industry, including offshore wind. They have been a major contributor for many years to advancing these goals.

2) Academic-based

a) Texas Tech University – National Wind Institute (NWI)

NWI has a very active R&D wind program which works in conjunction with one of the top graduate-level educational programs in the US.

b) University of Maine - DeepCWind Consortium and Advanced Structures & Composites Center

The U of M is dedicated to advancing the science and technology of offshore wind energy and associated research to make this happen.

c) Clemson University - Restoration Institute

Clemson hosts one of that larges blade and drive train testing facilities in the world at the SCE&G energy Innovation Center. They are able to these components under real world and extreme conditions in their facility.

Each of these organization can be instrumental partners with BSEE in refining inspection protocol and safety procedures. These organizations can also be very beneficial in driving towards a safer and more economical future for the wind industry as a whole. It is recommended that a healthy and mutual exchange of information is maintained, which benefits all parties.

3.17.2. R&D facilitation

One area which BSEE can act in a crucial manner is the in collection of data from the OWF. This can be especially valuable in the collection of reliability data for the turbines and major components of the turbines, such as the blades, gearboxes and generators. Also, since condition monitoring in general is fairly new to the industry, the sharing of information from this sector could be very beneficial. BSEE is in a unique position to be collecting this data as a matter of course, and after any proprietary information or identification is removed, could then disseminate this to a neutral third party for further analysis.

Up to this point, the gathering of reliability data has been hampered due to the voluntary nature of the request and the reluctance of manufactures and owner/operators willing to share this data. Without this data, research by the organizations listed above has, in general, been hampered. If they had access to quality data, then the ensuing analysis will be of greater value.

But for this to happen, BSEE will have to directly stipulate that they will be collecting this data but keeping source identification and proprietary property secure. BSEE does not have concern itself with the actual analysis, but only to gather and filter effectively. This will be a service to the entire industry as well as toward the public good.

3.18. Inspections and Certification

This section addresses what types of inspections/audits/evaluations or certifications are already performed for OWFs (e.g., project certifications, type certifications).

3.18.1. Type Certification

Type certification of a wind turbine involves independent review of the design of the wind turbine and standard tower design to a certain wind class. Type certification does not cover the offshore substructure, influence of wave loading, or other offshore installations. Type certification encompasses a review of the designers' assumptions, methodology, and calculations, as well as prototype measurements and tests. Type certification is required in all reviewed markets as a basic requirement prior to installation.

As long as the wind turbines to be installed in an OWF conform to the type certified design, and the site specific loads on the wind turbine are within the loads envelope defined in the type certificate, further design review is not required for the installation.

3.18.2. Standards for Type Certification

3.18.2.1. IEC International Standard

IEC 61400-22 International Standard Wind turbines – Part 22: Conformity testing and certification[191] states the methods and requirements for type certification of wind turbines. The standard contains the following requirements for inspections to be carried out during the installation, operation, and testing of a new wind turbine type:

The purpose of type testing is to provide data needed to verify power performance, aspects that are vital to safety and need additional experimental verification, and any other aspects that cannot be reliably evaluated by analysis. Type testing comprises the elements shown in Figure 5.

The certification body shall evaluate that testing of these aspects, as applicable, has been carried out on a turbine or component of a turbine representative of the type to be certified. Inspection records shall be completed, preferably prior to the tests, to demonstrate satisfactory conformity of the turbine or component with the design documentation. The detailed test program shall be defined by the applicant and be subject to approval by the certification body on a case by case basis.

The type testing elements given in Figure 43 and the duration test shall be carried out by an accredited testing laboratory or the certification body shall verify that the party conducting the testing complies with at least the criteria of ISO/IEC 17025 or ISO/IEC 17020, as applicable. The requirements for the duration test are described in IEC 61400-2.

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[191] IEC 61400-22 International Standard Wind turbines – Part 22: Conformity testing and certification http://webstore.iec.ch/

The certification body shall require that the testing and the test results be documented in a test report. This test report shall be evaluated by the certification body to ensure that the tests have been carried out in accordance with the approved detailed test program and that the test report properly documents the aspects required for certification. The certification body shall verify by inspection that critical personnel safety features have been satisfactorily implemented in the installed wind turbine to be tested.

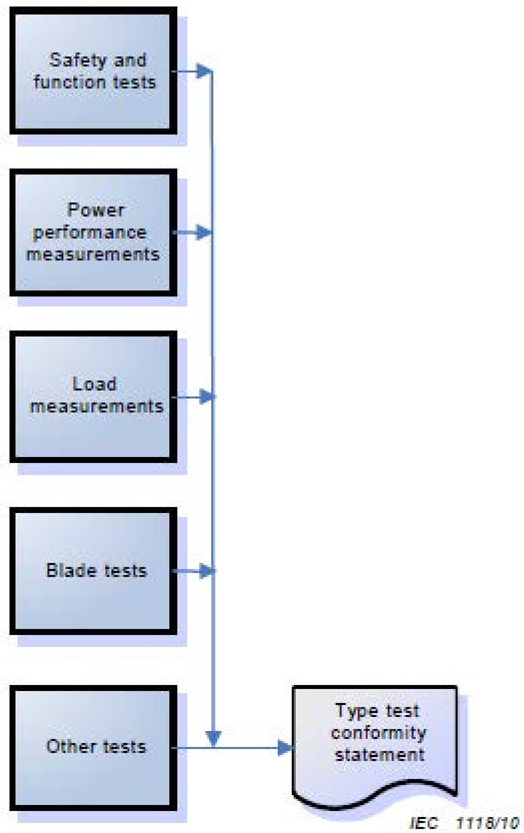

Figure 43 Type testing required by IEC[192]

Manufacturing evaluation

General

The purpose of manufacturing evaluation is to assess if a specific wind turbine type is manufactured in conformity with the documentation design verified during the design evaluation. This evaluation shall include the following elements:

a. quality system evaluation; and

[192] 61400-22 Ed. 1 2010-05 International Standard Wind turbines – Part 22: Conformity testing and certification http://webstore.iec.ch/

b. manufacturing inspection.

The manufacturing evaluation presupposes that the manufacturer of the wind turbine and the main components operates a quality system. It requires manufacturing of at least one representative specimen of the type under certification.

Quality system evaluation

The requirement for evaluation of the quality system is satisfied if the quality system is certified to be in conformance with ISO 9001. This system certification shall be carried out by an accredited body that operates according to ISO/IEC 17021.

If the quality system is not certified, the certification body shall evaluate the system of the applicant. The following aspects shall be evaluated:

a. responsibilities;
b. control of documents;
c. sub-contracting;
d. purchasing;
e. process control;
f. inspection and testing;
g. corrective measures;
h. quality recordings;
i. training; and
j. product identification and traceability.

Manufacturing inspection

It shall be ensured that the requirements identified during the design evaluation with regard to critical components and critical manufacturing processes are observed and implemented in production and assembly. The certification body shall verify by inspection that at least one representative specimen is manufactured according to the design under certification.

The inspection shall comprise:

a. verification that design specifications are properly implemented in workshop;
b. workshop instructions, purchase specifications and installation instructions;
c. evaluation of manufacturer's workshop, if relevant;
d. verification of fabrication methods, procedures and qualifications of personnel;
e. review of material certificates;
f. random checks on effectiveness of procedures for acceptance of purchased components; and
g. random checks of fabrication processes.

Inspection of critical components shall take place at the wind turbine manufacturer unless the manufacturer's incoming goods inspection is insufficient to ensure that the requirements identified during the design evaluation are met.

Type characteristic Tests

The purpose of type characteristic measurements is to establish performance-related characteristics of the wind turbine type, other than measurement of power performance, which is a mandatory element of type testing (Subclause 8.4.3). These optional measurements may be selected by the applicant and shall conform with the relevant IEC 61400 standards listed in the following subclauses. The type characteristics measurements comprise one or more of the elements:

a. power quality tests;
b. low voltage ride through tests; and
c. acoustic noise measurements

3.18.2.2. GL Guideline

Germanischer Lloyd's G*uideline for the Certification of Offshore Wind Turbines*[193] provides a methodology and requirements for performing type certification of wind turbines. The guideline contains the following guidance on inspections to be carried out during installation, operation, and testing of a new wind turbine type:

Marine Operations

Marine operations, i.e. operations associated with moving or transporting an offshore structure or parts thereof during the construction, installation or abandonment process, can have decisive influence on the overall design and on the dimensioning of the offshore wind turbine; see Section 4.4.3.12 and Chapter 6. Marine operations affecting the structural integrity are therefore normally included in the design review by GL. Where such operations, e.g. loadout, transportation, lifting / launching, upending, levelling, piling, floatover / lifting, mating and lowering / embedding, impose important loads or critical conditions on the structure, they have to be taken account of in the design.

A complete certification of the design and construction of an offshore wind turbine will be based on inspections of seafastening and all important transport and installation operations (see Section 1.2.3.6). Inspection of seafastening and marine operations will cover, as far as applicable:

a. condition inspection of vessels and equipment involved
b. loadout procedure including quay condition, mooring and retrieval system
c. transportation arrangements including seafastening, stability and towing

[193] Guideline for the Certification of Offshore Wind Turbines Edition 2012 http://www.gl-group.com/en/certification/renewables/CertificationGuidelines.php

d. lifting / launching / upending procedure (rigging, mooring and clearances)
e. installation procedures including anchor handling, positioning, piling, grouting and mating

The necessary extent of such inspections will be agreed upon in each individual case and certified accordingly. The operations shall be conducted by the responsible personnel of the service company in charge, which is assumed to be competent and adequately experienced for the respective tasks.

The sea transport and offshore installation manual (see Section 9.1) shall cover all relevant procedures and limiting conditions, and shall be approved by GL.

Construction phases of a platform (e.g. of concrete) in a floating, moored condition are not understood to be within the scope of this Section.

Testing of Offshore Wind Turbines

Prototype test

The measurements needed for a new turbine type within the scope of a prototype test are listed in Section 1.2.2.7, while further requirements are described in Sections 10.2 to 10.7 and 10.9. For the procedure to be followed after completion of the measurements, see para 8. The scope of the prototype test can be reduced for turbine variants or modified turbines after consultation with GL, provided that the prototype test was performed in its entirety for a predecessor turbine.

The measurement points, the planned scope of the measurements, and their assessment shall be coordinated with GL before installation of the measurement equipment commences. The influence of a turbine variant on the measurement result shall be assessed by GL and the accredited institute which performed the measurements on the original installation.

All measurements as per Sections 10.2 to 10.6, 10.7.3 and 10.9 shall be carried out and documented by a test institute accredited for these measurements. Alternatively, the test of the turbine behaviour as per Section 10.5, the load measurements as per Section 10.6 and the prototype test of the gearbox at the wind turbine as per Section 10.7.3 can be carried out by the manufacturer after prior consultation with GL, and then checked and witnessed by a test institute accredited for these measurements. In all cases, the accredited institute shall be responsible for compliance with the fundamental standards and with the requirements of this Guideline.

The gearbox prototype test at the wind turbine as per Section 10.7.3 forms part of the prototype test. Within the scope of the Type Certification, additional vibration measurements for the verification of the drive train dynamics analysis are necessary; see Section 7.10 and Appendix 7.B.

The prototype tests as per Section 10.2 through 10.7 performed at a prototype test turbine onshore may be regarded as being sufficient for the offshore turbine with respect to the requirements for prototype testing. The compliance of the design of the test turbine with the design on which the offshore certification is based has to be shown. See also Section 10.1.1.2 para 1.

If a prototype turbine onshore is used for the prototype tests as per para 3, then it is advisable to select a site at the sea coast to achieve the highest possible similarity with marine atmospheric and wind conditions.

The witnessing of the commissioning as per Section 10.8 has to be performed on one of the offshore turbines to be certified. If that is not possible because of the issuance of A-Design Assessment before installation of the offshore turbines, then the witnessing may be performed on a prototype turbine onshore. The compliance of the design of that prototype turbine with the design on which the offshore certification is based has to be shown. After installation of an offshore turbine, the witnessing of the commissioning may be carried out again on this offshore turbine, if necessary.

On completion of the measurements, the following activities shall be performed:

a. evaluation and documentation of the measurements
b. plausibility check of the measurement results
c. comparison of the measurement results with the assumptions in the design documentation

The respective documents are to be submitted to GL for assessment.

Requirements for the offshore wind turbine to be tested

The offshore wind turbines at which the measurements as per Sections 10.2 to 10.6 or the trial as per Section 10.7.3 are carried out shall conform to the greatest possible extent with the design or variety of designs on which the offshore certification is based. Compliance shall be confirmed in a declaration by the manufacturer. Any deviations in design shall be reported to GL and the accredited institute before the measurement takes place. This shall be done in a separate document, discussing, reasoning and listing all deviations. This document is to be submitted by the manufacturer. If the compliance is adequate for the corresponding test purpose, the measurement can be used for the certification.

The test institute performing the measurements shall record the identifications and data on the nameplates of the surveyed plant and on the nameplates of the primary components (at least the rotor blades, gearbox, generator and tower) and shall include them in the measurement report.

Periodic Monitoring

Objective of Periodic Monitoring

Periodic Monitoring is an inspection of the offshore wind turbine including substructure by a technical expert of GL. The inspection shall be carried out according to the conditions in the Certification Reports. Inspection intervals are laid down in the corresponding Certification Reports, their annexes, or indirectly in the form of references (see Section 1.2.3.9 para 1).

The objective of Periodic Monitoring is the examination (inspection) of the machinery, the safety devices and the structural integrity of the entire offshore wind turbine.

The body responsible for the offshore wind turbine (called the operator in the following) shall arrange for Periodic Monitoring.

Requirements for the technical expert

Periodic Monitoring shall be carried out by a technical expert for wind turbines who is approved by GL. The expert shall have the necessary technical knowledge for assessment of the complete offshore wind turbine. The relevant training and a continuous exchange of experience shall be proven. An accreditation according to DIN EN ISO/IEC 17020 or 45011 or equivalent is required, or the aptitude of the expert shall be checked by a competent examination board and accepted by GL.

The technical expert shall be independent and shall have access to the relevant technical documentation of the wind turbine.

Scope and execution

Basis of assessment for Periodic Monitoring

Periodic Monitoring shall be assessed on the basis of the present Guideline. Standards and regulations valid at the site shall be observed and applied.

Documentation of the wind turbine to be inspected

a. At least the following documentation shall be perused for Periodic Monitoring:
b. approval and / or certification reports, including all annexes and supplements
c. building and operation permit
d. operating manual
e. filled-out commissioning record
f. filled-out maintenance checklist (maintenance records) of at least the last maintenance
g. reports of previous Periodic Monitorings or condition surveys, e.g. condition-based monitoring measurements (if available)
h. proof and result of the annual oil quality check (at least the two last ones) of gear and hydraulic components
i. documentation of modifications / repairs to the turbine and necessary approvals, if relevant
j. reports of inspection of scour protection or seabed level
k. reports of inspection of the underwater structures and splash zone
l. annual report (e.g. trend analysis) of the monitored (by a CMS; see Chapter 13) wind turbine components (at least the two last reports).

Scope of Periodic Monitoring

The turbine shall be checked by visual inspection, whereby the individual components (including the rotor blades) shall be examined closely and the areas to be examined shall be cleaned or uncovered if relevant.

Structural integrity of the offshore wind turbine including machinery, and functioning of the safety and braking systems, shall be checked as well (see Table 11.1.1).

The scour protection, seabed level, underwater structure and splash zone shall be checked by GL or GL-approved experts on site.

The structure within the splash zone shall be inspected visually with regard to corrosion, condition of welds, marine growth and damage, e.g. from collision. Generally, marine growth must be removed for inspection. Where damage is found that could extend further down, diver inspections may be called for. Plate thickness measurements may be required where there is evidence of excessive corrosion. This shall be stated in the inspection report.

The concrete surfaces shall be inspected for cracks, abrasion, spalling and any signs of corrosion of the steel reinforcement and embedments, particularly in the splash zone, in areas exposed to sea ice, and where repairs have been carried out previously. Cleaning of the surface may be necessary. The result of the inspection shall be stated in the inspection report.

The type, location and extent of corrosion control (i.e. coatings, cathodic protection system etc.) as well as its effectiveness, and repairs or renewals shall be stated in the inspection report.

Execution of Periodic Monitoring

During Periodic Monitoring, the complete offshore wind turbine including the rotor blades shall be inspected thoroughly. A specific checklist for the inspection shall be prepared on the basis of the documentation. The checklist shall also contain the assessment criteria.

3.18.3. Project Certification

Project certification of an OWF involves independent review of the site specific design elements and integrated design of the installed structures. The design review includes assessment of environmental conditions, integrated load simulation, and strength calculation of the structure. If the tower design is site specific, it will be included in the project certification. Project certification encompasses a review of the designers' assumptions, methodology, and calculations, as well as inspections during the manufacturing, installation, commissioning, and operation phases.

Regarding the inspections required for project certification, also refer to section 2.16 Inspections at Commissioning.

3.18.4. Standards for Project certification

3.18.4.1. IEC International Standard

IEC 61400-22 International Standard Wind turbines – Part 22: Conformity testing and certification states the methods and requirements for project certification of wind farms. The standard contains the following requirements for inspections to be carried out during the operation phase of the wind farm:

Wind turbine/RNA manufacturing surveillance

General

The type certification of the wind turbine is based on design evaluation, type testing and measurements as well as manufacturing evaluation, including quality system evaluation and manufacturing inspection. The evaluation of quality system mainly relies on the presence of a certified ISO 9001 system. The manufacturing inspection during type certification is based on one specimen only. The project certification will in addition to this include inspection/audit activities (surveillance), in order to verify that the manufacturing of wind turbines for the specific project is carried out according to the approved design and with the intended quality.

Surveillance requirements

The extent of inspection and audits to be carried out for project certification will be evaluated for each single project and wind turbine type. The certification body will tailor a scope of work for inspection service. This scope will include use of international standards together with input from the design evaluation. Such input from the design evaluation may be:

a. critical items/processes identified during the design evaluation;
b. test programs/procedures for serial production;
c. approved design documentation such as drawings and specifications; and
d. details from prototype testing.

The following items will typically influence the detailed scope for the inspection service:

a. the manufacturer's experience with respect to delivery of the specific item to wind turbines;
b. the certification body's experience with the manufacturer;
c. time schedule and number of items for the specific delivery;
d. number of production plants;
e. type of manufacturing process, e.g. hand lay-up or vacuum injection of laminates, manual or automatic welding, etc.;
f. type of quality control e.g. NDT or visual inspection, statistical methods or testing each item, etc.;
g. appropriateness of the manufacturer's quality system in relation to the specific manufacturing process and control activities;
h. extent of inspection by purchaser, e.g. manufacturer's inspection on case of subsupplies;
i. availability of certified documents specifying the quality requirements;
j. manufacturing codes and standards applied, e.g. national or international;
k. availability of relevant quality control documents such as requirements for final manufacturing documentation, test programs, acceptance test procedures, NDT procedures, weld procedures, corrosion protection, handling, curing, heat treatment, mechanical testing requirements, etc.;
l. access to the manufacturing facility's sub-suppliers and manufacturing documents; and

m. procedures for handling of deviations to requirements, e.g. waiver procedures.

Support structure manufacturing surveillance

General

The following summarizes the work related to survey during manufacture of the support structure.

The project certification shall include inspection/audit activities in order to verify that the manufacture of support structure(s) for the specific project is carried out according to the approved design and with the intended quality.

It is a precondition for the manufacturing surveillance of the support structure that the manufacturer of the support structure or the main parts of the support structure operates a quality system. The inspection/audit activities shall focus on the quality system implemented during manufacture and evaluate that the quality system is appropriate.

Surveillance requirements

The extent of inspections and audits to be carried out for a project certification shall be determined for each project. The following processes may be subject to evaluation, depending on the type of structure:

a. manufacture of steel plates;
b. manufacture of primary load-carrying steel structure;
c. manufacture of secondary steel structure (deck, ladders etc.); and
d. build of concrete structures.

For each of these processes, the certification body shall tailor a scope of work for Inspection service. This scope shall include utilization of international standards together with input from the design evaluation. Such input from the design evaluation may be:

a. critical items/processes identified during the verification of final design documentation; and
b. approved design documentation such as drawings and specifications.

The following items will also typically influence the detailed scope for the inspection service:

a. the manufacturer’s experience with respect to delivery of the specific item for incorporation in support structures;
b. the certification body’s experience with the manufacturer;
c. time schedule and number of items for the specific delivery;
d. number of production plants;
e. type of manufacturing process, e.g. hand lay-up or vacuum injection of laminates, manual or automatic welding, etc.;
f. type of quality control, e.g. NDT or visual inspection, statistical methods or testing each item, etc.;

g. appropriateness of the manufacturer's quality system in relation to the specific manufacturing process and control activities;
h. extent of inspection by purchaser, e.g. manufacturer's inspection on case of subsupplies;
i. availability of certified documents specifying the quality requirements;
j. manufacturing codes and standards applied, e.g. national or international;
k. availability of relevant quality control documents such as requirements for final manufacturing documentation, test programs, acceptance test procedures, NDT procedures, weld procedures, corrosion protection, handling, curing, heat treatment, mechanical testing requirements, etc.;
l. access to the manufacturing facility's sub-suppliers and manufacturing documents; and
m. procedures for handling of deviations to requirements, e.g. waiver procedures.

Project characteristics measurements

The purpose of project characteristics measurements within project certification is to establish performance-related characteristics of a specific wind turbine or wind turbine project at a specific site, in addition to the measurements done for a single turbine within the type certification. These optional measurements may be selected by the applicant and shall conform to the relevant IEC 61400 series standards. The measurements comprise one or more of the elements:

a. grid connection compatibility according to grid codes;
b. verification of power performance; and
c. verification of acoustic noise emission.

In cases where applicable IEC standards are not available, the measurement procedure shall be agreed between the applicant and the certification body.

The measurements shall be carried out by an accredited test laboratory or the certification body shall verify that the party conducting the testing complies with at least the criteria of ISO/IEC 17020 or ISO/IEC 17025, as applicable.

Measurements and test results shall be documented in a test report evaluated by the certification body. The certification body shall evaluate that the measurements have been carried out in accordance with an approved detailed program and that the report properly documents the characteristics required for certification.

Transportation and installation surveillance

The purpose of transportation and installation surveillance is to verify conformity with the requirements of the design basis and to verify that the loads on components and subsystems of the wind turbines are not exceeding the design envelope during transportation and installation and that possible transportation and/or handling damages are being detected.

If a quality management system is in place for the transportation and installation processes, surveillance may be carried out by auditing. If not, the certification body shall perform the surveillance by inspection.

The certification body shall evaluate from documentation whether the transportation and installation processes of the wind turbine(s) are in conformance with the design basis and the requirements in the relevant IEC 61400 series standard, i.e. IEC 61400-1, IEC 61400-2 or IEC 61400-3.

The certification body shall ensure that components are inspected for damage that may have occurred during transport and handling. This is including, but not limited to, damage to corrosion protection or actual corrosion. After completion of the installation, a final visual inspection of all relevant components shall be made.

For offshore projects, surveillance shall include:

a. monitoring of sea-transportation;
b. compliance with respect to acceptable weather conditions during transport and installation; and
c. compliance with the support structure and wind turbine installation procedures.

Verification, inspection and surveillance activities shall be concluded with reports that describe the activities carried out.

Commissioning surveillance

The purpose of commissioning surveillance is to verify that the wind turbines installed in a specific project at a specific site are commissioned in conformity with the relevant manuals included in the design documentation (see 8.9).

Commissioning surveillance requirements

The certification body shall evaluate whether the commissioning of the wind turbine(s) is in conformance with the instructions supplied by the manufacturer in accordance with relevant parts of the IEC 61400 series. Other tests to be performed during commissioning in addition to tests in accordance with the general instructions may be agreed with the manufacturer.

This evaluation requires examination of commissioning records. In addition, the certification body shall witness the commissioning of at least one wind turbine and additionally at least one wind turbine per every 50 turbines in the project.

The certification body shall as a minimum verify that:

a. the commissioning instructions supplied by the manufacturer are adequate;
b. the instructions supplied by the manufacturer are followed during commissioning; and
c. the final commissioning reports are complete.

Verification and surveillance activities shall be concluded with reports that describe the activities carried out.

Operation and maintenance surveillance

General

The purpose of operation and maintenance surveillance is to establish that a specific wind turbine installation or wind turbine project at a specific site is operated and maintained in conformity with the relevant manuals included in the design documentation (see 8.9).

This surveillance requires examination of operation and maintenance records as well as inspection of turbines and other installations and parts which are covered by the project certificate.

Operation and maintenance surveillance shall be carried out at regular intervals on the basis of an agreement between applicant and certification body. The agreement shall specify the intervals and the extent of the surveillance. An operation and maintenance surveillance conformity statement shall attest compliance under the terms of this agreement.

Operation and maintenance surveillance requirements

The certification body shall evaluate operation and maintenance records and reports. The evaluation shall as a minimum establish that:

a. maintenance has been carried out by authorized and qualified personnel in accordance with and at the intervals specified in the maintenance manual;
b. the control settings have been checked with regard to conformance with the limiting values specified in the design documentation; and
c. all repair, modification and replacement (RMR) has been carried out in accordance with the certificate by reviewing RMR-reports.

In combination with this, the certification body shall inspect the general condition of the turbines and other installations that are covered by the certificate. The extent of the inspection shall be based on:

a. the evaluation of operation and maintenance records and reports;
b. status of outstanding findings from previous inspections;
c. status of outstanding recommendations from previous inspections; and
d. status of ongoing RMR-projects.

3.18.4.2. ABS Guideline

The ABS *Guideline for Certification of Offshore Wind Farms*[194] provides a methodology and requirements for performing project certification of OWFs. The guideline contains the following guidance on inspections to be carried out during the operation phase of the wind farm:

An agreement with ABSG for periodic surveys during the operation and maintenance of the certified offshore wind farm constitutes part of the requirements for renewing the Project Certificate. Under the agreement, ABSG will conduct periodic surveys to verify that the operation and maintenance of the offshore wind farm are in accordance with the approved Operating and Maintenance Manuals and Procedures and in compliance with the approved designs.

Surveys during operation and maintenance involve documentation reviews and periodic on-site surveys for the offshore wind turbines and Other Installations covered by the Project Certificate. Detailed scope of the surveys will be agreed to between ABSG and the Owner. Requirements and recommendations for the surveys are described in 3/13.2. The scope of the surveys is to include such aspects as the survey activities, the survey intervals, the number of offshore wind turbines to be surveyed at each survey interval, and reporting requirements.

Upon satisfactory completion of the agreed periodic surveys, a Statement of Compliance may be issued annually to renew the Project Certificate.

Requirements for Surveys during Operation and Maintenance

The Operating and Maintenance Manuals and Procedures for the offshore wind farm should be submitted to ABSG for review. The requirements applicable to the scope and contents of the Operating and Maintenance Manuals and Procedures are described below:

a. For the Bottom-founded Offshore Wind Turbines, refer to IEC 61400-3, Section 14.4 and 14.5
b. For the Floating Offshore Wind Turbines, refer to 1-1/11 of the ABS FOWTI Guide and the applicable part of IEC 61400-3, Section 14.4 and 14.5
c. For the Other Installations, refer to applicable part of the ABS Offshore Installation Rules and the ABS FPI Rules, or other recognized industry standards.

ABSG will verify that the Operating and Maintenance Manuals and Procedures are consistent with the relevant operation and maintenance requirements considered in the approved designs.

A Survey and Inspection Plan should be developed and submitted to ABSG for review and approval. The periodical surveys will be carried out by ABSG in accordance with the approved Survey and Inspection

Plan to confirm that the items covered by the Project Certificate remain in compliance with the applicable certification requirements and other relevant standards. The Survey and Inspection Plan

[194] Guideline for Certification of Offshore Wind Farms

should cover all surveys relevant to the renewal of the Project Certificate for the design life of the offshore wind farm.

Prior to the surveys, the status of outstanding items (see 2/7), outstanding findings and recommendations from previous surveys, and all revisions made to the Operating and Maintenance Manuals and Procedures since the last survey should be submitted for review.

For the RNAs, the periodic surveys on the annual basis may be required for a selected number of the RNAs in the offshore wind farm. ABSG will review the operating and maintenance records to verify that:

Operations of the RNAs have been carried out in accordance with the approved Operating and Maintenance Manuals and Procedures

a. Control settings of the RNAs have been regularly checked against the limiting values specified in the design documentation
b. Maintenance of the RNAs has been carried out in accordance with the approved Operating and Maintenance Manuals and Procedures and by qualified personnel
c. All repairs, modifications and replacements made to the RNAs are in compliance with the RNA type certificate and the Project Certificate requirements

For the RNAs, the surveys will also include inspections and, if applicable, witnessing of tests of the main components and systems such as:

a. Blades, hub, shaft and main nacelle structures
b. Mechanical systems
c. Electrical equipment and systems
d. Control systems
e. Protection systems
f. Personnel safety equipment, systems and installations
g. Corrosion protection systems

For other items and installations of the offshore wind farm covered by the Project Certificate, the recommended scope for surveys during operation and maintenance are listed in 3/Table 2.

Risk-based Surveys during Operation and Maintenance

A properly developed risk-based inspection plan or reliability centered maintenance plan may be credited as satisfying requirements of surveys during operation and maintenance for the offshore wind farm. The

plan should be developed by the Owner in accordance with the ABS Guide for Surveys Using Risk-Based Inspection for the Offshore Industry and the ABS Guide for Surveys Using Reliability-Centered Maintenance.

The application of the ABS guides referenced above does not cover any statutory survey requirements that may apply to the offshore wind farm. The Owner should ensure that in developing the risk-based inspection plan, due consideration is given to all applicable requirements.

4. Approaches to OWF Regulation and Inspection (Task 3)

This section constructs a list of possible approaches to OWF regulations and inspections that describe different roles which BSEE can fulfill based on the assessment of the wind energy regulatory landscape performed in Task 1 and Task 2 above. This part of the study discusses the advantages and disadvantages of each approach.

4.1. Onus of Inspections

This section addresses whether BSEE should conduct its own inspections, audits, or evaluations of OWF operations or rely on independent third party certifications (including type or project certification) of OWF operations or allow wind farm operators to self-inspect, self-certify, or self-report OWF operations; or some combination these methods. The role of inspecting OWF is an arduous task at best. Wind turbines are some of the largest and most complex devices made and in operation. And OWT's in particular are also in a difficult place to access and in a harsh environment which is not conducive to mechanical or electrical devices. Add to that the pioneering status of the industry as a whole, and the specter of OWF inspection is formable.

4.1.1. Logistics

OWF's are positioned for their wind resource potential and access to demand centers, not for their ease of access. Just the simple matter of transporting the inspectors to the turbine is a challenge, whether it is over sea or by air. These logistics problems require that a team of dedicated, trained professionals are involved in directly or assist in the actual IEA. The majority of the OWF's will be placed at some distance from shore, to travel between a service port and the OWF will require the inspectors, in association with the service craft and crew, to travel on the open sea, to the OWF site. They will also have to manage with projects which are placed on both coasts, and eventually the Gulf and Great Lakes. Project completion will likely be impacted by weather as well as other logistical anomalies. For these reasons, which are expanded upon in the following sections, it is recommended that having a third party body which maintains trained inspectors who are ready to be dispatched throughout the US, is a logical approach to completing the necessary field work for all phases of OWF inspection surveys.

4.1.1.1. Crew travel and transfer

Once at the site, transfer between the craft to the turbine is a challenge in itself. Whether it be attempted via service craft or helicopter, the latter not necessarily the easier. Because of the inherent risk, the proper equipment, training and experience is crucial to ensure safe transmission to and from the WT.

4.1.1.2. Timing and Planning

Another factor that will bring a challenge to managing OWF inspection relates to timing and planning. Orchestrating the various resources to get the properly trained personnel and material to the OWF. Also, even with all this planning, the weather conditions still has a say in this process.

4.1.1.3. Depth and Breadth of industry

Currently, there are only a handful of sites under serious consideration to becoming full functioning OWF's. These are concentrated on the Eastern seaboard with the exception of the Principal Power project in Oregon. But for the next 5 to 10 years, the demand for OWF inspection should be fairly low and concentrated on the manufacturing and installation phases. If the offshore wind industry does grow into its potential, there could be OWF's on both coasts and before too long in the Gulf and Great Lakes regions.

4.1.1.4. Training

The personnel who conduct the onsite inspections will be required to have the proper training and equipment. If BSEE where to field and maintain this team, they will have to comply with these requirements and keep them in a current and ready state. This topic is covered in depth in section 3.7.

4.1.2. Long View

4.1.2.1. Historical Perspective

The offshore wind industry is in a nascent developmental stage in the US. There are a handful OWF's currently still in the developmental phases with no actual working OWF's in US waters as this report is being written. While there is over ten years of experience in other countries, notably in Europe, the industry as a whole is still in a pioneering developmental stage. Much can be learned from more mature industries, such as offshore oil and gas, for BAST practices towards efficient inspection protocols. But there undoubtedly be growing pains at all levels of developing a coherent OWF inspection protocol due to the pioneering nature of current development.

Due to this pioneering stage, the depth of knowledge is rather shallow compared with more mature fields. This is especially true in contrast to more mature industries such as offshore oil and gas development and production.

4.1.2.2. Collaborative Sharing

An efficient manner for assisting the global offshore wind industry in this maturation process is for a collaborative and open sharing of information and knowledge as it becomes apparent. Of course, this is about information and knowledge which is of non-proprietary nature. BSEE is in a unique position to be able to collect operational and performance data and filter the sensitive or private data. BSEE could then work with other organizations, such as NREL or Sandia, whom are uniquely positioned to analyze and report lessons learned to the wider community. While the various trade associations provide a venue for this kind of exchange, it is completely voluntary. Thus the fluidity of information exchange has been limited by competing competitive interests by the various WT manufacturers and WF owner/operators. BSEE is in a unique position to its government position and legal mandate to gather performance data while keeping proprietary data private and secure.

4.1.2.3. Responsible Growth

BSEE also has the duty and responsibility of working with the wind industry to create a safe work spaces and keep the environment from harm. Accomplishing these goals will also increase reliability and therefore acceptance of this new industry.

4.2. Validity of Inspections Records of Wind Farm Operators

This section addresses whether the approach would allow BSEE to rely on reviews of wind farm operator records (e.g., permits, repair records).

4.2.1. Self-Evaluation positives

The primary benefit to relying on self-evaluation will be the simplicity of access. The owner/operators will have personnel on the turbines during all phases of the OWF life (as covered in section 3.4). This argument is especially realistic for the O&M phase, in which owner/operators will be conducting routine inspection and maintenance operations on the turbines. During this time, the frequency and import of inspection burden from the perspective of BSEE is much lower. There is then a higher incentive for all concerned to have self-evaluation with a strong audit process during this phase. Because of the heightened level of HSE issues during the commissioning and decommissioning phases, as described in detail in section 2.17, and the lessened barriers to access during these times, the rationale of relying solely on self-evaluation is of less merit.

Another point towards relying solely on owner/operator inspection reports, especially during the O&M phase, has to do with a relative small number of installations over the next few years. During the next five years, there will only be the few demonstration OWF projects in operational status. Those projects will also each consist of a very small number of WT's. This is due to the developmental and pioneering stage which offshore wind development is here in the US. Over time, it is expected that each of these early projects will expand to become farms containing hundreds of turbines. Also, with success of these demonstration projects, the number of projects can be expected to expand.

While a driving motivation for the owner/operator to conduct regular inspections is to maintain the reliability and health of the asset. There will likely also be economic drivers in the form of avoiding fines as well as maintaining good standing with the relevant insurance agencies. This is the case for other land-based industries who have legal responsibilities to report non-compliance or accidents to the corresponding bodies, such as OSHA or EPA. And it is in the economic interest in these companies to comply with both the insurance company's criteria as well as regulatory and policing agencies.

If during any phase of the life of the OWF, it is decided to rely on owner/operators records as the primary input for inspection data, then there will be a shift of importance to what the level of fines and other punitive measures which are instituted to increase the confidence of those records. The potential economic effect from non-compliance will have to weigh as heavy as the primary and direct economic drivers of maintaining the OWF in a high state of performance.

4.2.2. Objective reality

During the more active periods of the turbine life, such as installation and commissioning, the risks become much higher. During the developmental stage which the offshore industry currently is in, this risk is expanded further due to the potential inexperience by many of the participants to OWF in US waters. Also, during these stages of expanded activity, economic and schedule constraints can have adverse effect on owner/operators to maintain high levels of compliance. This pressure is expanded during these early years of the industry as a whole. Also, the difficulty of access argument is lessened by the increased activity during these periods, which provides expanded opportunities for 3rd party or BSEE inspectors to directly participate which the increased traffic between the site and the port.

The developmental stages of the OWF will already have independent oversight at all stages from the type certification process of the turbine design as well as the CVA body reviewing and verifying the project installation activities. For BSEE to inspect during these phases, it would be a parallel effort with the CVA and the added value would be minimal, except perhaps as an evaluation of the CVA performance.

So the questions of how much to rely on owner/operator reports and data are directly dependent on the phase of life of the project as well as where in the general developmental stage the industry as a whole is. Also, the value of the data received from owner/operators will be very dependent on the depth and breadth of the punitive measures in place as well as the effectiveness of BSEE to police those measures. This will be true for all phases. It is recommended that BSEE specify and communicate the punitive measures clearly too all parties so that it becomes a tool and not an obstacle to the truth. With that in place, the inspection burden can be shifted to the owner/operators for and only for the O&M phases.

4.3.Inspection Frequency Requirements

This section addresses how frequently BSEE would need to conduct or require inspections, audits, evaluations using this approach.

Offshore wind generation is a new industry in the US and fairly novel in general globally. Due to this, there is much to be learned about the specific challenges of safe and efficient utilization. This would tend to drive towards a higher frequency of inspection. But the difficulties and expense of OWF inspections counter this trend towards a reduced level of inspection.

In section 2.12, inspection frequency requirements are covered including the specific legal requirements in the US. Please refer to that section for further depth of coverage on this subject.

4.3.1. OWF Life-Cycle Stages

4.3.1.1. Design

The validity of the design of the wind turbine is covered in the Type Certification process by an independent third party certification body. In the US, the use of a CVA is mandated by the US government to review and verify an OWF project. A Statement of Compliance from the CVA or certification body is issued upon satisfactory completion of the review process. This is covered in further detail in section 3.19.

Adding additional design oversight of the WT design process would likely be counter-productive. For BSEE, the inspection activities during the design stage should entail a review the type certificate and the CVA statements of conformity, checking that they are current and valid. They should also review any reports generated by the CVA to evaluate their impact on future BSEE activities.

4.3.1.2. Manufacturing

Like the design process, for both onshore and offshore turbines, the validation of the manufacturing processes for the wind turbine are covered through the type certification processes. This will have included onsite inspections wherever those manufacturing facilities may occur. For OWF in the US, the CVA has the duty to inspect, audit and evaluate the manufacturing of all the components of the entire system, from the tip of the blade to the end of the foundation pile. This also includes onsite inspections. The role of the CVA is to verify that the previously validated design is being manufactured to the approved design and that the quality management system is working in the manner in which it was setup up.

It is not the expectation that BSEE would have to conduct onsite inspections during this phase of the OWF life. It should be sufficient to, like the design phase, review and record the type certificates, statements of conformity and any reports from the CVA. Also, for any components which are manufactured in the US directly, OSHA and the EPA would have federal jurisdiction over HSE matters.

4.3.1.3. Installation and Commissioning

While the wind turbine installation and commissioning plan is validated during the type certification process, much like the manufacturing plan before it. In the US, the CVA has the duty to inspect onsite the installation and commissioning process, and verify that it follows the plan.

It is during the installation and commissioning phases of an OWT life in which the risks to both workers and the environment will be at its highest, second only to the decommissioning phase. The installation phase is also the time in the project when the bulk of the activity happens either in port or offshore at the intended site, thus falling directly under the jurisdiction of the BSEE, not OSHA. This is also the phase when there will to be a multitude of distinct entities working in coordination with each other from the owner/operator, turbine manufacturer, crane operators, foundation fabricators and others. Because of this interactive nature, the exterior location, and large masses being lifted and assembled, there is a much higher risk level for accidents during this phase. As such, a higher level of scrutiny by either a 3rd party or BSEE directly is warranted.

4.3.1.4. Operations and Maintenance

An operations and maintenance (O&M) plan is part of the turbine manufacturing review in the type certification. In the US, the project O&M plan is authored by the owner/operator and reviewed by the CVA during the project review.

The owner/operator will be responsible to conduct the routine visits to keep the turbine in service to its fullest capacity. While there is no legal requirement for this activity, they will have a strong financial incentive to keep the maintenance current and the turbine operational to the best of their ability. It is expected that under normal circumstances, each turbine will have to be visited by a technician once a year for regular service and maintenance. Any unforeseen incidents which require a special trip would likely be outside of these regular service trips.

Any inspection by a BSEE inspector or by an approved and certified 3rd party inspector should consist of checking that the O&M plan is being followed as specified. This should be followed up with occasional onsite audits to verify the veracity of the O&M reports from the owner/operator. The interest from the BSEE perspective is less on the operational reliability than for ensuring that the public concerns from the HSE perspective are being met.

The frequency of these audit trips would be similar to what is performed by OSHA on ONWF sites. They would also likely have to occur during regular scheduled O&M visits. Due to the logistics and planning that goes into a trip to the OWF, there would have to be some advanced notification to the owner/operator that such a visit was pending.

4.3.1.5. Decommissioning

Under current practices, a plan for decommissioning is approved as part of the CVA or project certification process. Financial means for funding the decommissioning process are setup as part of the project approval process to guarantee the completion of this final stage, even if the owner/operators become fiscally irrelevant at that stage. This financial means can take the form of a bond, monies which held in escrow or some other form of fiduciary instrument to guarantee the turbines can be fully decommissioned, even if the owner/operator meets with unfortunate circumstances.

There is little to no direct experience to report in the offshore wind industry in actual decommissioning events due to its nascent stage. In the early days of ONWF’s, there have been cases where there have been wind farms in various stages of decay and decrepitude and even abandonment.

Like the installation phase, the decommissioning phase is point in the life of the turbine with much higher risk to both workers and possible environmental damage. As such, a higher level of scrutiny by either a 3rd party or BSEE directly is warranted. This is especially true due to novel nature within the wind industry.

4.3.2. Technical or Remote Inspections

Review of data remotely

- Performance data
- SCADA
- Conditional monitoring
- Unmanned or drone inspection

4.4.BSEE and Third Party Inspections

This section addresses whether BSEE could utilize and accept inspections performed by third parties under this approach. It also discusses what qualifications the third party inspection companies must have in order to satisfy the BSEE's safety requirements.

4.4.1.1. Design

As stated in section 4.3.1.1, the validity of the wind turbine design is covered in the Type Certification process by a certification body. The tower, foundation, grid connection and siting issues are covered under either the Project Certification process or by a CVA. During this phase of the turbine life, independent third parties are currently stipulated to conduct and report on the validity of the design. BSEE is recommended to review and record the findings of this process.

4.4.1.2. Manufacturing

As referenced in section 4.3.1.2, review and inspection of the manufacturing plan and its implementation is currently covered by third party certifying bodies such as the type certifier and CVA. They are mandated to verify that the components are being manufactured to the validated design. BSEE is recommended to review and record the findings of this process.

4.4.1.3. Installation and Commissioning

The wind turbine installation and commissioning plan is validated during the type certification process, much like the manufacturing plan before it by an independent third party. In the US, the CVA, also a third party, has the duty to inspect onsite the installation and commissioning process, and verify that it follows the plan.

As stated in section 4.3.1.3, this is a critical phase of the OWT life with a much higher inherent level of risk for workers and the environment. As such, a higher level of scrutiny by either a 3rd party or BSEE directly is warranted. There will already be independent third party inspectors, both in port and on location, checking and verifying that the process is going as planned. It seems apparent that these same 3rd party inspectors could also perform the functions that are required by BSEE. They would be in the position to document and record the activities in the format and manner which would satisfy BSEE that all HSE matters are being covered.

4.4.1.4. Operations and Maintenance

As stated in section 4.3.1.4, both the wind turbine and project O&M plans are reviewed by an independent third bodies. The owner/operator will be responsible for conducting the routine visits to implement the plan.

It is often occurs in the onshore wind industry that the physical O&M services are conducted by companies whose specific function is to perform these duties. In such a case, it could be a part of their duty to report to BSEE specific events or observations as they appear.

4.4.1.5. Life extension and repowering

It is very possible that the OWF could see either a life extension or repowering stage before decommissioning. Life extension entails keeping the major components and performing the necessary overhaul to squeeze more years of service from the OWF. Repowering entails replacing major components of the OWF, such as the Rotor Nacelle Assembly, while keeping (with overhaul) the balance of plant.

As the OWF nears its scheduled end of life, a review process will evaluate the feasibility of either of these two options. If conducted, it will be similar to a smaller version of a decommissioning and installation phase, but adjusted depending on the particular nature of each case. As such, the inspection protocols would likely be similar to both the commissioning phase and the decommissioning phase.

4.4.1.6. Decommissioning

Under current practices, a plan for decommissioning is approved as part of the CVA or project certification process. Financial means for funding the decommissioning process are setup as part of the project approval process to guarantee the completion of this final stage, even if the owner/operators become fiscally irrelevant at that stage. It should be checked at various stages in the OWF life that the above mentioned financial means are still intact and viable.

There is little to no direct experience in the offshore wind industry in actual decommissioning events due to its nascent stage.

Like the installation phase, the decommissioning phase is a critical point in the life of the OWF with much higher risk to both workers and possible environmental damage. As such, a higher level of scrutiny by either a 3rd party or BSEE directly is warranted. This is especially true due to novel nature within the wind industry.

It would be easy to say that the decommissioning plan will be just the commissioning plan in reverse, this is not the case. Certain elements, such as undersea cables, may not be removed depending on each case. Also, removal of bolts and hardware which has been in a marine environment for twenty or more years will likely be more difficult. The foundation for example may be grouted to pilings, which may require that they be cut off via welding at, near or below the mudline. All of these steps have to be done in a safe manner. Oversight of the process is vital to ensure a safe and effective removal of the WT while ensuring a safe working environment and minimal impact on the environment.

4.5.BSEE's Role in Witnessing Tests

This section addresses if there are tests on turbines or transmission lines that BSEE should witness under this approach.

The testing of the turbine is currently covered under type certification by an independent third party certification body. The certification body maintains a full range of qualified experts in their respective technical fields so as to be able to evaluate using the BAST at that time. Through the type certification process, the design is qualified that if meets current BAST as spelled out in the design basis. Then the manufacturing of the first units as well as the quality control process is evaluated by this same certification body. Finally, the testing of the major components are witnessed and evaluated. This whole process validates that the turbine design will operate safely and effectively.

In the US, the OWF project is verified by a certified verification agent (CVA) which is an independent body with no financial or physical connections to any of the manufacturers or developers. It too maintains a qualified technical staff, like the certification body. They review and report of the design basis and the other design documentation for the OWF site, verify the applicability of the turbine, foundation and balance of plant, and inspect the manufacturing of the major components. They also witness the installation and commissioning of the turbines to verify that all is in accordance to the project design basis, current laws and regulations within the jurisdiction of the site.

If it is deemed by BSEE that they would want to also witness testing of major components of the OWF, then they will be doing so in parallel with the CVA. This duplication of inspections will invariably add to the complexity and cost of the project with a minimal potential return. It would be essentially evaluating and fully auditing the quality of the specific CVA's function and its output in the process. The CVA will be in direct communication with BSEE and share all final reports with them. It is logical for BSEE to work in concert with the CVA, utilizing this partnership to advantage of all. If for any reason, BSEE questions the work of the CVA, then that should be taken up in that, and only that particular case. But to institute the additional parallel effort without cause would be unwise.

4.6. Best Practices for Inspections of Onshore Components

The subject of inspection, audit, or certification of onshore components of OWFs, including onshore electrical metering systems is covered in sections 2.16 and 3.6.

4.7. Training for BSEE Inspectors

This section we address what training approach BSEE would require to provide for its inspectors. As stipulated by BSEE, there is focus on basic safety training as well as specialized training for the inspection of offshore wind turbines, OSPs and electrical transmission lines.

Training requirements for occupational health & safety and environment have augmented as the complexity of wind farm developments increased. The lessons learned from earlier wind farm developments also showed that the wind energy industry needs to improve training regime in order to ensure that all persons working on wind farm projects, regardless whether there are built onshore or offshore, receive adequate safety training for their respective tasks.

Currently it is observed that different level of training requirements for inspection wind turbines worldwide exists. For instance, in the UK and other western European countries, the following training certificates are generally required to be able to work at wind turbines or inspect wind turbines.

It is recommended that BSEE require any worker or inspector, who wants to work in a wind turbine to have at least the following training before working or carrying out any inspections at wind farms:

a. Wind Turbine Climber Training
b. Confined Space Training
c. Electrical Safety Training
d. Ladder Safety Training
e. PPE Inspection Training

f. Onshore Basic Safety Training
g. Offshore Basic Safety Training (for OWFs)
h. Basic Offshore Safety Induction and Emergency Training (for OWFs)
i. Offshore First Aid Training
j. Risk Assessment Training

The Global Wind Organization (GWO), which is an association of WTG owners and manufacturers with the aim of supporting an injury-free work environment in the wind industry, has developed a standard for Basic Safety Training (Onshore/Offshore). A comprehensive list of basic safety training requirements can be found in this standard[195], as we are able to share the content of the publication due to copyright protection. According to GWO, the standard was developed in response to the demand for basic safety training standard in the onshore and offshore wind energy industry. The standard was prepared in co-operation between GWO members. The work involving the preparation of the standards was based on risk assessments and actual incident/accident data within the onshore and offshore industry relating to WTG installation, operation and maintenance activities.

4.7.1. Wind Turbine Climber Training

Wind turbine climber training is designed for engineers/inspectors who are required to access or work on wind turbines. The training, which is normally is for two days, includes the elements of safe systems of work, equipment selection and inspection, risk assessment, wind turbine safety rules, emergency procedures, evacuation and rescue using appropriate wind turbine descent equipment. This training is designed to provide participants with the practical experience and knowledge to:

a. Carryout a risk assessment of work at height issues including requirements for rescue
b. Demonstrate the ability to select and use a range of PPE for work at height including climber's harness
c. Show that climber knows the correct method of storing and handling and care of his/her PPE
d. Climb and work at height using lanyards and associated safety equipment
e. Know the use of correct rescue equipment, evacuation techniques and
f. Use suspension trauma and emergency procedures
g. Carry out rescues and evacuation from nacelle or ladder

After successful completion of a training session, participants are issued with a certificate with an expiration date (for example wind turbine climber training certificate is valid for 2 years in the US and in the UK).

[195] Basic Safety Training (Onshore/Offshore) Standard, Global Wind Organisation, 2014 http://www.windpower.org/download/2277/GWO_BST_Standard_Version_6%2C_12_March%2C_2014.pdf

4.7.2. Working at Height Training

This training program includes introduction of applicable legislation such as Working at Height Regulations in the UK and demonstrations of workers suspended in a harness from scaffolding, hand rails and ladders. Training course is designed to help participants to comply with the applicable regulations by providing participants with the necessary information needed to be able to successfully deal with working at height risks and control measures; this includes an understanding of how to undertake a working at height risk assessment, how to use access equipment safely and how to ensure that employees can reduce their risk of falls from height. After successful completion of a training session participants are issued with a certificate with an expiration date (for example working at height training certificate is valid for 2 years in the UK).

4.7.3. Confined Space Training

The training is designed to provide participants with the knowledge and practical experience to enable them to safely enter a confined space and use escape breathing apparatus when required. The training includes confined space legislation review, atmospheric hazards and gas detection, risk assessments, distinction between types of Respiratory Protective Equipment (RPE), care & use of RPE, care & use of PPE, methods of communication in confined space, confined space access methods, emergency procedures, self-rescue. After successful completion of a training session participants are issued with a certificate with an expiration date (for example confined space training certificate is valid for 3 years in the UK).

4.7.4. Rope Access Training

The training program is designed to teach participants how to work safely using rope access technique. Normally 5 day-long course content includes a mixture of theory and supervised practical sessions. The theory section of the training covers characteristics of a safe system of work including equipment, legal requirements, objective hazards, risk assessment and method statements, conformity and certification, inspection, emergency considerations and rescue procedures. It also teaches basic principles of movement on ropes including ascent, descent, changing from ascent to descent, changing from rope-to-rope, crossing a knot, aid climbing and traversing, passing re-anchors and deviations, use of a back-up system, elementary rigging and rope management, elementary rescue. Practical part involves actual use of rope access technics. After successful completion of a training session participants are issued with a certificate with an expiration date (for example rope access training certificate is valid for 3 years in the UK).

4.7.5. Ladder Safety Training

The training program is designed to equip participants with the knowledge, skills and confidence necessary to use ladders legally and safely. Ladder safety training addresses issues raised by applicable legislations such as the Health and Safety at Work Act 1974 and the Working at Height Regulations 2005 in the UK. Under such regulations the users of ladders has a duty of care both to themselves and others to know and understand the practical implications of working at height. After successful completion of a training session participants are issued with a certificate with an expiration date (for example, ladder safety training certificate is valid for 5 years in the UK).

4.7.6. IPAF Training

This training is required for using elevating platforms used for blade inspections at ONWFs. International Powered Access Federation (IPAF) operator training is designed to enable operators to maneuver, drive and position the Mobile Elevating Work Platforms (MEWPs) safely and proficiently. The course normally includes scissor lifts, boom lifts (static or mobile), truck mounted or trailer mounted platforms. After successful completion of a training session participants are issued with a Powered Access License (PAL) Card, which is valid for 5 years.

4.7.7. PPE Inspection Training

This training is offered in the UK. As addressed before, there is a legal duty to ensure that all fall protection PPE are inspected at suitable intervals (for example as per Regulation 12 (3) of the Work at Height Regulations 2005 in the UK). This training course is provided to train participants to make a decision on the state or condition of fall protection equipment item and whether to keep it in service. The PPE inspection course goes through the responsibilities of the Duty Holder, current PPE legislation and LOLER 1998 Regulations in the UK, equipment marking procedures, record production procedures, inspection procedures, fault diagnosis and controlled disposal procedures. On successful completion on the training, delegates receive a Powered Access License card, which is valid for five years.

4.7.8. Basic Offshore Safety Induction and Emergency Training

The training course is designed for personnel intending to work on an offshore installation, such as OWFs and offshore substations. The course provides an awareness of the hazards encountered when travelling to and from offshore installations, offshore safety regime and safety management systems. It also includes theoretical and practical training in sea survival, including first aid, basic fire-fighting and self-rescue, helicopter safety and escape. Basic Offshore Safety Induction and Emergency Training (BOSIET) takes 3 days to complete. After successful completion of a training session participants are issued with a certificate with an expiration date (for example BOSIET training certificate is valid for 4 years in the UK).

4.7.9. Marine Safety Training

This two day training course, which is accredited by both RenewableUK and Global Wind Organization, is devised to provide basic safety training and competence required by personnel intending to work in the offshore wind energy sector. The course is designed to address the significant health and safety issues that relate to vessel transit and transfer under the jurisdiction of UK Health and Safety at Work, etc. Act 1974. It is intended to ensure a common approach to basic training delivered by an approved training provider under controlled conditions. The course, which is currently offered in the UK, introduces participants to the health and safety law governing offshore wind operations as well as an overview of the UK and European offshore wind industry and facilities under construction. The other areas covered include vessel transfer theory and practical training and vessel emergencies theory and practical. After successful completion of a training session participants are issued with a certificate with an expiration date (e.g. ladder safety training certificate is valid for 2 years in the UK).

4.7.10. Onshore Basic Safety Training

The training contains four modules including working at heights module, manual handling module, first aid module and fire awareness module. The working at heights module gives the participants training in using basic protective equipment for the use of working safely at heights while providing basic rescue at heights training involving both theoretical and a practical components. The manual handling module gives the participants training to carry out manual handling of various items in multiple scenarios, which includes both theoretical and practical components. The first aid module gives the participants training in providing effective and safe first aid to other persons; this module also includes both theoretical and practical components. The fire awareness module gives the participants training in the use of basic fire extinguishing equipment during minor fires in various scenarios; individuals are also trained to perform a safe evacuation in case of fire. This module also has both theoretical and practical components. After successful completion of a training session participants are issued with a certificate with an expiration date (for example onshore basic safety training certificate is valid for 2 years in the UK).

4.7.11. Offshore Basic Safety Training

In addition to the modules covered in the onshore basic safety training, there is one more module included in the offshore basic safety training, which is sea survival module. This module gives the participants basic knowledge and skills to use possible aids/rescue equipment and methods which can be used from when they stand on port by departure until they have returned safely; the training contains both theoretical and practical components. After successful completion of a training session participants are issued with a certificate with expiration dates (for example certificate part, related to onshore modules, is valid for 2 years and certificate part related to offshore module is valid for 4 years in the UK).

4.7.12. Offshore First Aid Training

The four day offshore first aid training course is designed for persons wishing to learn first aid which qualifies them to act as the first aider in the workplace or at an offshore WTG or OSP under applicable regulations such as the Health and Safety (First-Aid) Regulations 1981 in the UK. After successful completion of a training session participants are issued with a certificate with expiration dates (for example offshore first aid training certificate is valid for 2 years in the UK).

4.7.13. Risk Assessment Training

This theory-based training course is designed to give participants an understanding of the depth and quality of content required in the production and completion of lifting plans and risk assessments. The course content also helps auditors and inspectors in the process of assessing the adequacy of risk assessment practices. Course includes:

a. Organization of Lifting Operations
b. Categorization of Lifting Operations
c. Self-Assessment Cards
d. Lift Description

e. Weight of the Load
f. Planning Considerations
g. Step-by-Step Procedure
h. Rigging Procedure Diagrams
i. Route to be Travelled
j. Rigging Material Lists
k. Risk Assessment
l. Theoretical Planning Exercises

After successful completion of a training session, participants are issued with a certificate with expiration dates (for example risk assessment training certificate is valid for 3 years in the UK).

There are other training courses for very specific activities, but those 13 training courses covered in this section are the most important ones for technicians, engineers and inspectors who are assigned to work on OWF and ONWF sites including onshore and offshore substations for the wind farms.

It is recommended that BSEE require any worker or inspector, who wants to work in a wind turbine to have at least the following training before working or carrying out any inspections at wind farms:

k. Wind Turbine Climber Training
l. Confined Space Training
m. Ladder Safety Training
n. PPE Inspection Training
o. Onshore Basic Safety Training
p. Offshore Basic Safety Training (for OWFs)
q. Basic Offshore Safety Induction and Emergency Training (for OWFs)
r. Offshore First Aid Training
s. Risk Assessment Training

The Global Wind Organization (GWO), which is an association of WTG owners and manufacturers with the aim of supporting an injury-free work environment in the wind industry, has developed a standard for Basic Safety Training (Onshore/Offshore). A comprehensive list of basic safety training requirements can be found in this standard[196], enabled to share the content of the publication due to copyright protection. According to GWO, the standard was developed in response to the demand for basic safety training standard in the onshore and offshore wind energy industry. The standard was prepared in co-operation between GWO members. The work involving the preparation of the standards was based on risk assessments and actual incident/accident data within the onshore and offshore industry relating to WTG installation, operation and maintenance activities.

[196] Basic Safety Training (Onshore/Offshore) Standard, Global Wind Organisation, 2014 http://www.windpower.org/download/2277/GWO_BST_Standard_Version_6%2C_12_March%2C_2014.pdf

4.7.14. Electrical Safety Training

Wind turbine electrical safety training is designed for engineers/inspectors who are required to access or work on wind turbines. The training, which is minimum two days, includes general electrical safety as well as wind turbine specific considerations. This training is designed to provide participants with the practical experience and knowledge of:

a. General safe working practices and OSHA regulations for electrical installations

b. Lock-out tag-out (LOTO) procedures

c. Arc flash risks

5. Conclusions

This study examined the relevant state, national, international regulations and standards associated with OWF/ONWF and wind turbine inspections/audits/evaluations in countries where wind technology has been long adopted (Task 1), it reviewed the major safety and environmental concerns for the operation of OWFs in order to identify the critical structures and components, which should be subject to inspections (Task 2), and it constructed addressed possible approaches to OWF regulations and inspections that describe different roles which BSEE can fulfill based on the assessment of the wind energy regulatory landscape performed in Task 1 and Task 2 (Task 3).

The study of HSE regulations in respect to inspections, audits, assessment and evaluations has shown that the majority of regulators puts the onus of HSE compliance on employers and requires employers to assure that all wind farm related activities are carried out safely throughout the full life-cycle of a wind farm.

6. Glossary

Array Cable: Array cable (also referred to as inter-array cable), connects WTG to other WTGs and OSP to allow the power generated at each WTG to be collected before being sent on to shore.

Audiometry: It is a branch of Audiology and the science of measuring hearing acuity for variations in sound intensity and pitch and for tonal purity, involving thresholds and differing frequencies.

Caisson: It is a watertight retaining structure.

CDM Co-coordinator: A person is a duty holder under the UK CDM Regulations 2007 and is appointed by the Client (project owner). The role of CDM coordinator is to provide the client with a key project advisor in respect of construction health and safety risk management matters. CDM role is carried out by a third party to ensure unbiased approach.

Cofferdam: It is a temporary enclosure built within, or in pairs across, a body of water and constructed to allow the enclosed area to be pumped out, creating a dry work environment for the major work to proceed.

Competent Person: A competent person is someone who has sufficient training and experience or knowledge and other qualities that allow him/her to assist the wind farm owner or operator properly. The level of competence required will depend on the complexity of the situation and the particular help you need.

Confined Space: A confined space is any space including chamber, offshore WTG foundation, vessel, tank, silo, pit or other similar space that is largely enclosed (not always entirely) that contains a foreseeable specified risk of serious injury.

Cutting: Cutting is any method used to carve a space between tough rock/sediment where other subsea cable burial techniques fail, to allow cable to be laid. This usually involves a device with rotating teeth that is maneuvered along the sea floor.

Export Cable: It is the cable that transfers the power from OSP (the offshore AC substation or the offshore AC/DC converter station) to shore.

Fatality: Incident that involves one or more people who died as a result of a work-related incident or occupational illness. 'Delayed' deaths that occur after the incident are to be included if the deaths were a direct result of the incident.

First Aid: An injury which requires simple medical treatment that is self-administered or by a first aider, doctor or nurse, but does not result in lost time or long-term medical care.

Foehn Effect: The Foehn (German) is a generic term for warm strong and often very dry downslope winds that descend in the lee of a mountain barrier. Originally applied to effect of winds in the European Alps region, the term is now used for all similar winds. Foehn type winds are known for their rapid temperature rise, their desiccating effect and the rapid disappearance of snow cover.

Hazard: A hazard is a condition or a situation where there is a potential to cause an incident.

Hypoglycemic Attack: It is a medical emergency that involves an abnormally diminished content of glucose in the blood; it is normally known as low blood sugar. Its effects include seizures, unconsciousness, and (rarely) permanent brain damage or death.

Jetting: Jetting is any method or technology that is used to jet/pump water at a high power into the seabed at a targeted area to temporarily fluidize the sediment allowing the subsea cable to sink to a suitable burial depth under the subsea cable's own weight

Keystone Apparatus: It is vision screening equipment used by eye care professionals to measure visual acuity.

Lost Work Day: It is non-fatal incident that involves a person being unfit to perform any work on any day after the occurrence of the occupational injury. 'Any day' includes rest days, weekend days, leave days, public holidays or days after ceasing employment.

Medical Treatment Injuries: Non-fatal incidents that involve a person being unfit to perform any work on any day after the occurrence of the occupational injury. 'Any day' includes rest days, weekend days, leave days, public holidays or days after ceasing employment.

Met-Mast: It is a meteorological measurement tower, which carries meteorological measuring instruments such as thermometers and wind velocity measurers; it is used to collect site specific meteorological data for OWF and ONWF projects during the planning phase.

Near Hits: A near hit is any incident which could have resulted in a work related accident but did not, either by chance or timely intervention.

Notifiable Project: An OWF or ONWF construction project which involves more than 30 days or 500 man days of construction work.

Percutaneous Coronary Intervention: Commonly known as coronary angioplasty or simply angioplasty, is a non-surgical procedure used to treat the stenotic (narrowed) coronary arteries of the heart found in coronary heart disease.

Personal Fall Protection System: It is the fall prevention, work restraint, work positioning, fall arrest or rescue system, other than a system in which the only safeguards are collective safeguards; or rope access and positioning techniques.

Ploughing: Ploughing is any method used whereby a tool, usually a sedge, is used to cut a furrow into the seabed allowing the subsea cable to fall into the space created before passing over the subsea cable to shift sediment back on top.

Principal Contractor: A company that plans manages and monitors the construction phase of an OWF or ONWF project. Normally the project owner acts as the principal contractor in the UK.

Restricted Work Day: It is an incident that does not result in a fatality or a lost work day but does result in a person being unfit for the full performance of the regular job on any work on any day after the occurrence of the occupational injury.

Snellen Chart: It is an eye chart used by eye care professionals and others to measure visual acuity. Snellen charts are named after the Dutch ophthalmologist Hermann Snellen.

Spirometry: It (meaning measurement of breath) is the most common of the respiratory function tests measuring lung function, specifically the amount (volume) and/or speed (flow) of air that can be inhaled and exhaled.

Swept Path Analysis: It is an analysis of the movement and path of different parts of a vehicle carried out to assess a vehicle's turning maneuver capability. At a basic level this includes calculating the path taken by each wheel during the turn and also calculating the space needed by the vehicle body during the turn.

Theodolite: It is a precision instrument for measuring angles in the horizontal and vertical planes.

Trenching: Trenching is any method or technology that cuts an open trench in the seabed for cable installation, for example by using a vessel-mounted back-hoe.

Work at Height: It is a place of work including a place at or below ground level; obtaining access to or egress from such place while at work, except by a staircase in a permanent workplace.
Working Platform: It means any platform used as a place of work or as a means of access to or egress from a place of work and includes any scaffold, suspended scaffold, cradle, mobile platform, trestle, gangway, gantry and stairway which is so used.

7. Documents Reviewed

As part of this study, ABSG undertook comprehensive document review. This includes regulations, standards, guidelines, articles, reports and studies. The literature ABSG reviewed during the study is listed in the Table 39 below.

Row	Country	Title	Issuer	Link	Pub Date	Rev
1	EU	2013 Annual Incident Data Report	G9 Offshore Wind Health and Safety Association	http://www.g9offshorewind.com/__data/assets/pdf_file/0011/106121/G9report-finalversion-WEB.pdf	2013	0
2	UK	A Survey of Failures in Wind Turbine Generator Systems with Focus on a Wind Farm in China	Ran Bi, Kejun Qian, Chengke Zhou, Donal M Hepburn, Jin Rong	http://www.ijsgce.com/uploadfile/2014/1105/20141105103115712.pdf	2010	-
3	US	ABS Guide for Surveys Using Risk-Based Inspection for Offshore Industry	ABS	http://ww2.eagle.org/en/rules-and-resources/rules-and-guides.html#/content/dam/eagle/rules-and-guides/current/offshore/120_surveys_riskbasedinspectionoffshoreindustry	2003	0
4	UK	Application of IRATA International Rope Access Methods for Work on Wind Turbines	Industrial Rope Access Trade Association	http://www.google.co.uk/url?url=http://irata.associationhouse.org.uk/show_doc.php%3Fdoc_id%3D4466&rct=j&frm=1&q=&esrc=s&sa=U&ei=JEfnVIDDB5Lvatb-gvAI&ved=0CBoQFjAB&usg=AFQjCNGj-eZyKvfVPxZWvJEqlfp2_2RD7Q	2014	
5	UK	Assessing Underwater Noise Levels during Pile-driving at an Offshore Wind Farm and its Potential Effects on Marine Mammals (Abstract)	Helen Bailey, Bridget Senior, Dave Simmons, Jan Rusin, Gordon Picken, Paul M. Thompson, Marine Pollution Bulletin	http://www.abdn.ac.uk/lighthouse/documents/Bailey_Assessing_underwater_2010_MPB.pdf	2010	0
6	Int.	Basic Safety Training (Onshore/Offshore)	Global Wind Organization	http://www.windpower.org/download/2277/GWO_BST_Standard_Version_6%2C_12_March%2C_2014.pdf	2014	6
7	US	Best Available and Safest Technologies for Offshore Oil and Gas Operations: Options for Implementation	The National Academy of Engineering	http://www.nap.edu/download.php?record_id=18545#	-	-

Row	Country	Title	Issuer	Link	Pub Date	Rev
8	DE	Betriebssicherheitsverordnung (BetrSichV) (*German Occupational Safety Act*),	by law	http://www.gesetze-im-internet.de/bundesrecht/betrsichv/gesamt.pdf	2002	
9	DE	BG provision, regulation, information and axiom	BG Bau	http://www.bgbau-medien.de/struktur/inh_gese.htm	various	
10	UK	Breaking Down the Cost of Wind Turbine Maintenance	David Milborrow	http://www.windpowermonthly.com/article/1010136/breaking-down-cost-wind-turbine-maintenance	2010	-
11	UK	BS EN 3-1:1996 Portable Fire Extinguishers	BS	http://www.hse.gov.uk/cdg/pdf/fire-ex.pdf	1996	0
12	EU	BS EN 50308:2004 Wind turbines. Protective measures. Requirements for design, operation and maintenance	BSI	http://shop.bsigroup.com/ProductDetail/?pid=000000000030143430	2004	-
13	BG	Bulgarian Regulations	Various	Please see Appendix I	-	-
14	UK	Burbo Bank Extension Offshore Wind Farm, Environmental Statement	Dong Energy	http://infrastructure.planningportal.gov.uk/wp-content/ipc/uploads/projects/EN010026/1.%20Pre-Submission/EIA/Scoping/Scoping%20Request/100708_EN010026_EIA%20Scoping%20Report.pdf	2013	0
15	UK	Competence in Health and Safety	Health & Safety Executive	http://www.hse.gov.uk/competence/	online	
16	UK	Confined Space Regulations 1997	Health & Safety Executive	http://www.legislation.gov.uk/uksi/1997/1713/contents/made	1997	0
17	UK	Construction (Design and Management) Regulations 2007	Health & Safety Executive	http://www.legislation.gov.uk/uksi/2007/320/contents/made	2007	0
18	UK	Construction (Health, Safety and Welfare) Regulations 1996	Health & Safety Executive	http://www.legislation.gov.uk/uksi/1996/1592/contents/made	1996	0
19	UK	Crown Estate Act 1961	UK Government	http://www.thecrownestate.co.uk/media/5305/crown-estate-act-	1961	0

Row	Country	Title	Issuer	Link	Pub Date	Rev
				1961-text.pdf		
20	DK	Danish Working Environment Act	Danish Working Environment Authority	http://engelsk.arbejdstilsynet.dk/en/Regulations/acts/Working-Environment-Act.aspx	various	
21	DK	Danish Working Environment Authority	Danish Working Environment Authority	http://arbejdstilsynet.dk/da/	various	
22	DK	Danish Working Environment Authority No. 1101	Danish Working Environment Authority	http://engelsk.arbejdstilsynet.dk/en/Regulations/Executive-Orders/1101-Hejseredskaber-og-spil.aspx	1992	
23	DE	Design of Offshore Wind Turbines, BSH-No. 7005,	BSH	http://www.bsh.de/en/Products/Books/Standard/index.jsp	2007	
24	DE	DGUV Information 203-007 - Windenergieanlagen (bisher: BGI 657),	DGUV	http://www.arbeitssicherheit.de/de/html/library/document/5004841,1	2006	
25	DE	DIN EN 3 Portable fire extinguishers	DIN EN	http://www.fnfw.din.de/projekte/DIN+EN+3-8+rev/en/128979277.html	various	
26	EU	Directive 89/391/EEC - OSH "Framework Directive"	European Agency for Safety and Health at Work	https://osha.europa.eu/en/legislation/directives/the-osh-framework-directive/1	1989	-
27	EU	Directive 89/686/EEC on Personal Protective Equipment	European Commission	http://ec.europa.eu/enterprise/sectors/mechanical/documents/legislation/personal-protective-equipment/index_en.htm	1989	-
28	UK	Diving at Work Regulations 1997	Health & Safety Executive	http://www.legislation.gov.uk/uksi/1997/2776/contents/made	1997	0
29	IE	Draft IWEA Standard Transport of Abnormal Loads Consultation	Irish Wind Energy Association	http://www.iwea.com/transportation	2011	0
30	IE	Draft PPS18: Renewable Energy Annex 1 Wind Energy Planning Issues	The Department of the Environment (Northern Ireland)	http://www.planningni.gov.uk/index/policy/policy_publications/planning_statements/pps18/pps18_annex1/pps18_annex1_wind/pps18_annex1_planning/pps18_annex1_electromagnetic.htm	2014	0

Row	Country	Title	Issuer	Link	Pub Date	Rev
31	UK	Electricity (Guarantees of Origin of Electricity Produced from Renewable Energy Sources) Regulations 2003	Health & Safety Executive	http://www.legislation.gov.uk/uksi/2003/2562/contents/made	2003	-
32	UK	Electricity Safety, Quality and Continuity Regulations (Northern Ireland) 2012	Health & Safety Executive	http://www.legislation.gov.uk/nisr/2012/381/contents/made	2012	-
33	EU	EN 547-2:1996:2008 Safety of machinery. Human body measurements. Principles for determining the dimensions required for access openings	BSI	https://law.resource.org/pub/bg/ibr/bds.en.547-3.1996.a1.2008.pdf	1997	-
34	UK	Environmental Impact Assessment for Wind Farms	Ruth Stevenson, BSc, MSc, PhD	http://gse.cat.org.uk/downloads/Environmental_Impact_Assessment_Consenting_Process_Windfarms.pdf	2006	-
35	UK	Environmental Protection Act 1990	Health & Safety Executive	http://www.legislation.gov.uk/ukpga/1990/43/contents	1990	-
36	DK	Executive Order on a technical certification scheme for wind turbines no. 73	Danish Energy Agency	http://www.wt-certification.dk/Common/2013%2005%2007%20Teknisk%20bkg%20engelsk%20oversættelse%20070513.pdf	2013	
37	DK	Executive Order on the Conditions at Permanent Places of Work	Danish Working Environment Authority	http://engelsk.arbejdstilsynet.dk/en/Regulations/Executive-Orders/96-Faste-arbejdssteders-indretning.aspx	2001	
38	DK	Executive Order on the Use of Work Equipment	Danish Working Environment Authority	http://engelsk.arbejdstilsynet.dk/en/Regulations/Executive-Orders/1109-Anvendelse-af-tekn-hjaelpemidler.aspx	1992	
39	DK	Executive Orders	Danish Working Environment Authority	http://engelsk.arbejdstilsynet.dk/en/Regulations/Executive-Orders.aspx	various	
40	UK	Fire Precautions (Workplace) Regulations 1997	Health & Safety Executive	http://www.legislation.gov.uk/uksi/1997/1840/contents/made	2003	0
41	FR	French Regulations	Various	Please see Appendix H	-	-

Row	Country	Title	Issuer	Link	Pub Date	Rev
42	DE	Frequency of Damage and Related Downtime	Wind Monitor	http://windmonitor.iwes.fraunhofer.de/windmonitor_en/3_Onshore/4_zuverlaessigkeit/7_schadenshaeufigkeit_und_ausfallzeit_je_schaden/	2010	-
43	DK	Global Wind Organization Standard – Basic Safety Training (BST) (Onshore/Offshore)	Global Wind Organization	http://www.windpower.org/download/2277/GWO_BST_Standard_Version_6%2C_12_March%2C_2014.pdf	2014	-
44	DE	Guidance for use of the of BSH standard 'Design of Offshore Wind Turbines'	BSH	http://www.bsh.de/en/Products/Books/Standard/index.jsp		
45	ENG/WAL	Guidance Note on Varying Consents Granted under Section 36 of the Electricity Act 1989 for Generating Stations in England and Wales	UK Government	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/252014/DECC_varying_consents.pdf	2013	0
46	ES	Guide for Assessing the Impact of Wind Farms on Birds and Bats	SEO / Bird Life	http://www.seo.org/2012/01/12/seobirdlife-presenta-una-nueva-guia-para-la-evaluacion-del-impacto-de-parques-eolicos-en-aves-y-murcielagos/	2012	0
47	Intl.	Guide for Building and Classing Bottom-founded Offshore Wind Turbine Installations	American Bureau of Shipping (ABS)	http://ww2.eagle.org/en/rules-and-resources/rules-and-guides.html#/content/dam/eagle/rules-and-guides/current/offshore/176_bowti	2014	
48	Intl.	Guide for Building and Classing Floating Offshore Wind Turbine Installations	American Bureau of Shipping (ABS)	http://ww2.eagle.org/en/rules-and-resources/rules-and-guides.html#/content/dam/eagle/rules-and-guides/current/offshore/195_fowti	2014	
49	Intl.	Guide for Building and Classing Wind Farm Support Vessels	American Bureau of Shipping (ABS)	http://ww2.eagle.org/en/rules-and-resources/rules-and-guides.html#/content/dam/eagle/rules-and-guides/current/offshore/200_windfarmsupportcraft	2013	

Row	Country	Title	Issuer	Link	Pub Date	Rev
50	Intl.	Guideline for Certification of Offshore Wind Farms	American Bureau of Shipping (ABS)	n/a	2014	
51	Intl.	Guideline for the Certification of Offshore Wind Turbines Edition 2012	Germanischer Lloyd (GL)	http://www.gl-group.com/en/certification/renewables/CertificationGuidelines.php	2012	
52	Intl.	Guideline for the Certification of Wind Turbines Edition 2010.pdf	Germanischer Lloyd (GL)	http://www.gl-group.com/en/certification/renewables/CertificationGuidelines.php	2010	
53	Intl.	Guideline for the Continued Operation of Wind Turbines Edition 2009	Germanischer Lloyd (GL)	http://www.gl-group.com/en/certification/renewables/CertificationGuidelines.php	2009	
54	DK	Guidelines for Executive Order on a technical certification scheme for wind turbines no. 73	Danish Energy Agency	http://www.dawt.dk/Common/2014%2003%2014%20BEK73%20vejledning%20udkast.pdf	2013	
55	UK	Health and Safety (First-Aid) Regulations 1981	Health & Safety Executive	http://www.legislation.gov.uk/uksi/1981/917/contents/made	1981	0
56	UK	Health and Safety at Work etc Act 1974	Health & Safety Executive	http://www.legislation.gov.uk/ukpga/1974/37/contents	1974	-
57	UK	Health and Safety at Work etc. Act 1974 (Application outside Great Britain) Order 2013	Health & Safety Executive	http://www.legislation.gov.uk/uksi/2013/240/contents/made	2013	-
58	IE	Health and Safety Guidelines for the Onshore Wind Industry	Irish Wind Energy Association	http://www.iwea.com/contentfiles/Onshore%20Wind%20Guidelines.pdf	2011	-
59	Intl.	IEEE Guide for the Planning, Design, Installation, and Repair of Submarine Power Cable Systems	IEEE	http://www.techstreet.com/ieee/searches/7571615	2005	
60	UK	Inspection and Report, Construction Information Sheet No 47	Health & Safety Executive	http://www.hse.gov.uk/pubns/cis47.pdf	2005	1
61	IT	Italian Regulations	Various	Please see Appendix G	-	-

Row	Country	Title	Issuer	Link	Pub Date	Rev
62	UK	Kentish Flats Offshore Wind Farm Extension Draft Environmental Statement Section 17: Aviation and Radar	Vattenfall Continental / UK Renewables Ltd	http://www.vattenfall.co.uk/en/file/110321_Section_17_Aviation_and_Radar__V3.0.pdf_17878789.pdf	2011	0
63	NL	Lethal Wind Turbine Accident in the Netherlands	Geenstijl	http://www.epaw.org/multimedia.php?lang=en&article=a19	2013	0
64	UK	Lifting Operations and Lifting Equipment Regulations 1998 (LOLER)	Health & Safety Executive	http://www.legislation.gov.uk/uksi/1998/2307/contents/made	1998	0
65	UK	London Array Onshore Substation	London Array Offshore Wind Farm, Masdar	http://www.londonarray.com/about-us-2/onshore-substation/	2014	-
66	UK	Management of Health and Safety at Work Regulations 1999	Health & Safety Executive	http://www.legislation.gov.uk/uksi/1999/3242/pdfs/uksi_19993242_en.pdf	1999	0
67	UK	Medical Fitness to Work – Wind Turbines, Guidelines for Near Offshore and Land based Projects	RenewableUK	http://www.renewableuk.com/en/publications/index.cfm/medical-fitness-to-work	2013	0
68	UK	Memorandum of understanding between the Gas and Electricity Markets Authority, the Health and Safety Commission and the Health and Safety Executive	Health & Safety Executive	https://www.ofgem.gov.uk/ofgem-publications/77123/memorandum-understanding.pdf	2011	-
69	UK	Merchant Shipping (Code of Safe Working Practices for Merchant Seamen) Regulations 1998	Maritime and Coastguard Agency, the Department for Transport	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/282659/coswp2010.pdf	1998	0
70	UK	Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2006	Maritime and Coastguard Agency, the Department for Transport	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/282220/mgn332a.pdf	2006	0
71	UK	Merchant Shipping and Fishing Vessels (Provision and Use of Work Equipment) Regulations 2006	Maritime and Coastguard Agency, the Department for Transport	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/282215/mgn331.pdf	2006	0

Row	Country	Title	Issuer	Link	Pub Date	Rev
72	US	MMS TA&R Project 627 – Inspection Methodologies for Offshore Wind Turbine Facilities	Energo Engineering Inc	http://www.nap.edu/booksearch.php?booksearch=1&term=MMS+TA%26R+Project+627+%E2%80%93+Inspection+Methodologies+for+Offshore+Wind&record_id=18327	2009	0
73	US	MMS TA&R Project 650 – Offshore Wind Turbine Inspection Refinements	Energo Engineering Inc	https://download.nap.edu/login.php?record_id=18327&page=/download.php?record_id=18327	2010	0
74	EU	Occupational Safety and Health in the Wind Energy Sector, European Risk Observatory Report	European Agency for Safety and Health at Work	https://osha.europa.eu/en/publications/reports/occupational-safety-and-health-in-the-wind-energy-sector	2013	0
75	SE	Offshore Cable Installation - Lillgrund	Energimyndigheten	http://www.tet.tuhh.de/downloads/et-pbl/Vattenfall%20-%20Offshore-Kabelinstallation%20-%20Januar%202009.pdf	2009	0
76	UK	Offshore Injury, Ill Health and Incident Statistics 2011/2012	Health & Safety Executive	http://www.hse.gov.uk/offshore/statistics/hsr1112.pdf	2012	0
77	UK	Offshore Marine HS Guidelines 2014	RenewableUK	http://www.renewableuk.com/en/publications/index.cfm/2013-03-13-hs-guidelines-offshore-wind-marine-energy	2014	1
78	Intl.	Offshore Standard DNV-OS-D201 Electrical Installations	Det Norske Veritas AS (DNV)	https://exchange.dnv.com/publishing/Codes/download.asp?url=2011-04/os-d201.pdf	2011	
79	Intl.	Offshore Standard DNV-OS-J101 Design of Offshore Wind Turbine Structures	Det Norske Veritas AS (DNV)	http://www.gl-group.com/pdf/DNV-OS-J101_2014-05.pdf	2013	
80	Intl.	Offshore Standard DNV-OS-J201 Offshore Substations for Wind Turbines	Det Norske Veritas AS (DNV)	http://www.gl-group.com/DNV_Standard_DNV-OS-J201_%28November_2013%29.pdf	2013	

Row	Country	Title	Issuer	Link	Pub Date	Rev
81	EU	Offshore Transformer Platform Design for Safety	European Wind Energy Association (EWEA)	http://proceedings.ewea.org/offshore2009/allfiles2/214_EOW2009presentation.pdf	2009	-
82	UK	Offshore Wind Accelerator Access Competition - Shortlisted Designs	Carbon Trust	http://www.carbontrust.com/media/105306/owa-access-innovators.pdf	2010	-
83	UK	RP-2A-WSD – Planning, Designing, and Constructing Fixed Offshore Platforms - WSD	Wind Energy Update	http://www.windenergyupdate.com/offshore-wind-energy-operations-and-maintenance-report/?utm_source=PressRelease%2BMediaPartners%2B2511&utm_medium=PressRelease%2B2511&utm_campaign=2060	2011	-
84	US	Offshore Wind Energy Operations and Maintenance Report	API	http://www.api.org/~/media/files/publications/whats%20new/2a-wsd_e22%20pa.pdf	2014	-
85	UK	Onshore Wind Health & Safety Guidelines	RenewableUK	http://www.renewableuk.com/en/publications/index.cfm/Onshore-Wind-Health-and-Safety-Guidelines	2015	1
86	DK	Order on the design of technical equipment	Danish Working Environment Authority	http://engelsk.arbejdstilsynet.dk/en/Regulations/Executive-Orders/612-Indretning-af-tekniske-hjaelpemidler.aspx	2008	
87	UK	Pressure Systems Safety Regulations 2000	Health & Safety Executive	http://www.legislation.gov.uk/uksi/2000/128/pdfs/uksi_20000128_en.pdf	1999	0
88	UK	Provision and Use of Work Equipment Regulations 1998 (PUWER)	Health & Safety Executive	http://www.legislation.gov.uk/uksi/1998/2306/contents/made	1998	0
89	UK	Rampion Offshore Wind Farm Onshore Substation Design and Access Statement	E.ON	http://infrastructure.planningportal.gov.uk/wp-content/ipc/uploads/projects/EN010032/2.%20Post-Submission/Application%20Documents/Reports/8.2%20Onshore%20Substation%20Design%20and%20Access%20Statement%20(FINA	2014	A

Row	Country	Title	Issuer	Link	Pub Date	Rev
				L).pdf		
90	UK	Rampion Offshore Wind Farm Outline Cable Specification and Installation Plan	E.ON	http://infrastructure.planningportal.gov.uk/document/2155046	2013	A
91	DK	RBI Optimization of Offshore Wind Turbines	José G. Rangel-Ramírez & John D. Sørensen * Department of Civil Engineering, Aalborg University, DK	http://vbn.aau.dk/files/16623693/RBI_Optimization_of_Offshore_Wind_Turbines	2008	0
92	Intl.	Recommended Practice DNVGL-RP-0046 Qualification procedure for offshore high-voltage direct current (HVDC) technologies	Det Norske Veritas AS (DNV)	http://exchange.dnv.com/servicedocuments/currentVersion/dnvgl?DNVGL-RP-0046	2014	
93	Intl.	Recommended Practice DNV-RP-J301 Subsea Power Cables in Shallow Water Renewable Energy Applications	Det Norske Veritas AS (DNV)	http://exchange.dnv.com/publishing/codes/docs/2014-02/RP-J301.pdf	2014	
94	UK	Regulatory Controls, Offshore Energy Strategic Environmental Assessment - Appendix 5	Department of Energy & Climate Change	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/194352/OES_A5_Controls.pdf	2009	0
95	UK	Remote-controlled drone inspects met mast	Forewind	http://www.forewind.co.uk/news/104/34/Remote-controlled-drone-inspects-met-mast.html	2014	
96	UK	RenewableUK Training Standards	RenewableUK	http://www.renewableuk.com/en/our-work/health-and-safety/training/	2014	-
97	UK	Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR)	Health & Safety Executive	http://www.legislation.gov.uk/uksi/2013/1471/contents/made	2013	0

Row	Country	Title	Issuer	Link	Pub Date	Rev
98	DE	Rescue Chain Offshore Wind Research	BG Trauma Hospital Hamburg	http://www.buk-hamburg.de/files/rettungskette_offshore_englisch_web.pdf	2010	0
99	UK	Research Report 121 - Benchmarking the Competent Person in Manufacturing and Engineering Sectors, Engineering Employers Federation (South)	Health & Safety Executive	http://www.hse.gov.uk/research/rrpdf/rr121.pdf	2003	0
100	DE	Richtlinie für Windenergieanlagen - Einwirkungen und Standsicherheitsnachweise für Turm und Gründung	DIBt, German Center of Competence in Civil Engineering	https://www.dibt.de/en/DIBt/DIBt.html	2012	
101	UK	Risk Management of Wind Farm Projects, MBA Research Project	Jale Cairney, Imperial College London, Business School	n/a	2009	0
102	US	Selecting the Right Drivetrain Inspection Technology	Andrew Engle, Wind Systems Magazine	http://www.windsystemsmag.com/article/detail/620/selecting-the-right-drivetrain-inspection-technology	2015	
103	DK	Siemens D6 platform – 6.0-MW direct drive wind turbine,	Siemens AG	http://www.energy.siemens.com/hq/pool/hq/power-generation/renewables/wind-power/platform%20brochures/D6%20Offshore%20brochure_English_Apr2014_WEB.pdf	2014	0
104	US	Special Report 310 - Worker Health and Safety on Offshore Wind Farms	Transportation Research Board of National Academies	http://www.nap.edu/booksearch.php?booksearch=1&term=Special+Report+310+-+Worker+Health+and+Safety+on+Offshore+Wind+Farms&record_id=18327	2013	0
105	US	Special Repot 305_Structural Integrity of Offshore WTGs	Transportation Research Board of National Academies	https://download.nap.edu/login.php?record_id=13159&page=%2Fdownload.php%3Frecord_id%3D13159	2011	0

Row	Country	Title	Issuer	Link	Pub Date	Rev
106	UK	Structural Health Monitoring for Wind Turbine Foundations	Magnus Currie, Mohamed Saafi, Christos Tachtatzis and Francis Quail, Institution of Civil Engineers	http://www.academia.edu/6596292/Structural_health_monitoring_for_wind_turbine_foundations	2012	0
107	U	Study and Development of a Methodology for the Estimation of the Risk and Harm to Persons from Wind Turbines - R968 Report	MMI Engineering Ltd for the Health and Safety Executive	http://www.hse.gov.uk/research/rrpdf/rr968.pdf	2013	0
108	UK	Summary of Wind Turbine Accident Data to 30 September 2013	Caithness Windfarm Information Forum	http://www.caithnesswindfarms.co.uk/accidents.pdf	2014	0
109	CH	Swiss Regulations	Various	Please see Appendix F	-	-
110	US	Top 5 US Wind Energy Insurance Claims Report	Gcube	http://www.gcube-insurance.com/press/gcube-top-5-us-wind-energy-insurance-claims-report/	2013	0
111	UK	Vessel Safety Guide	RenewableUK	http://www.renewableuk.com/en/publications/index.cfm/vessel-safety-guide	2012	0
112	DK	WEA Guidline	Danish Working Environment Authority	http://engelsk.arbejdstilsynet.dk/en/Regulations/Guidelines.aspx	various	
113	CH	Wind Turbine Ice Throw Studies in Swiss Alps	René Cattin, Stefan Kunz, Alain Heimo, Gabriela Russi, Markus Russi, Michael Tiefgraber, White paper	http://www.meteotest.ch/cost727/media/paper_ewec2007_cattin_final.pdf	2009	0
114	Intl.	Wind turbines - Protective measures - Requirements for design, operation and maintenance; FprEN 50308:2013	DIN EN	http://www.beuth.de/en/draft-standard/din-en-50308-vde-0127-100-2014-03/199036146;jsessionid=X09VJNFQNB3AZ21YXEH1C71Z.4?	2013	
115	UK	Work at Height Regulations	Health & Safety Executive	http://www.legislation.gov.uk/uksi/2005/735/pdfs/uksi_20050735	2005	0

Row	Country	Title	Issuer	Link	Pub Date	Rev
				_en.pdf		
116	ES	Working in Confined Spaces-Best Practice Guide-Blades	Asociacion Empresarial Eolica (The Spanish Wind Energy Association)	http://www.aeeolica.org/uploads/documents/4160-working-in-confined-spaces-best-practice-guide-blades.pdf	2012	-
117	NI	Wind Energy Planning Issues (Ice Throw, Noise, safety, Lightning Strike, Shadow Flicker, Reflected Light, Proximity to Power Lines, Landscape etc.)	The Department of the Environment (Northern Ireland)	http://www.planningni.gov.uk/index/policy/policy_publications/planning_statements/pps18/pps18_annex1/pps18_annex1_wind/pps18_annex1_planning/pps18_annex1_landscape.htm	2014	-

Table 39 – Publications Reviewed by ABS Group[197]

[197] Please note that the lists of regulations reviewed are not included in this table. Please see appendices F, G, H and I for the full list of regulations.

8. Contributors

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Appendix A.

Operating Instruction for the Use of Rope Access Technique

OPERATING INSTRUCTIONS
For the use of Rope Access Techniques on WTGs

DANGERS FOR HUMAN BEINGS AND THE ENVIRONMENT

- Danger due to moving objects
- Danger due to hazardous weather conditions
- Danger due to damage to the rope section
- Danger due to lack of communication
- Danger due to outside influence/third parties
- Danger due to aerials
- Danger due to suspension trauma/orthostatic shock
- Danger due to failing anchorage points
- Danger due to failing equipment
- Danger due to electricity

SAFETY PROCEDURES AND CODE OF CONDUCT

- Comply with the User Instruction "Use of Rope Access Techniques".
- Work assignments must be led by an experienced supervisor.
- A task-specific risk identification and risk assessment must be carried out prior to commencement of inspections or maintenance works.
- The appropriate work processes must be selected on the basis of the risk identification.
- Emergency and rescue procedures must be planned in accordance with the risk identification.
- At least two trained and equipped users must be within calling distance and in visual contact on each assignment.
- A constant safety connection must be ensured in areas where there is a risk of falling as well as a redundant safety connection when working in the rope system.
- Work using Rope Access Techniques on the WTG must only be performed in suitable weather conditions:
  - In stormy weather, work must be halted immediately and the WTG must be evacuated immediately.
  - Work using Rope Access Techniques must be halted in excessively strong winds.
- Operating the WTG:
  - The WTG must only be operated by qualified persons.
  - The WTG must be put into a safe operating condition (Stopping of the WTG).
  - The WTG must be secured against inadvertently switching on again (maintenance position).
  - The remote surveillance team in charge must be informed.
  - The wind direction of the WTG must be deactivated.
  - The rotor must be secured (safety bolts).
  - The rotor blades must only be pitched, when there is no personnel in the danger area.
- Anchorage Points:
  - Only select sufficiently load-bearing and robust anchorage points (min. 10 kN).
  - Only use structurally safe anchorage points (Rings on main gear/gearbox/machine support).
  - Compliance with the rope process must be ensured, and the rope sections must be protected.
- Communication:
  - Ensure sufficient communication.
- Determine and secure the danger area below the work area.
- Compliance with the Country Legislation for Rope Access of Health & Safety rules must be ensured.

CONDUCT IN THE EVENT OF FAILURES

- The work process can only be started, when emergency and rescue procedures are ensured.
- Damaged equipment must immediately be taken out of service.
- Every safety-relevant incident must immediately be reported to the supervisor.
- In the event of hazardous weather conditions, work must be halted immediately.
- If people are present in the danger area, work must be halted immediately, and only when the danger area is clear, can the work be resumed.

ACCIDENTS, FIRST AID

☎ Emergency No:......... → WHO/WHAT/WHERE/HOW MANY/WAIT

- All work must be halted immediately.
- Stay calm/Speak to the injured/Assess the situation/Check for danger and plan measures.
- Make an emergency call: Who/What/Where/How many/Wait for any queries, give exact description of the location and appoint a guide.
- The rescue must be launched immediately, taking into account the situation.
- After reaching the injured party, perform first aid and take further measures in accordance with the person's condition.
- Position conscious persons in the harness in a half-sitting/squatting or crouching position.
- Position unconscious persons in the recovery position and monitor vital body functions.

INSPECTIONS- MAINTENANCE – DISPOSAL

- The equipment must be stored in accordance with the manufacturer's instructions, away from harmful effects.
- Damaged, contaminated and unusable equipment must be taken out of service immediately.
- The equipment must be checked by the user before, during and after use.
- The equipment must be checked once a year by a specialist/qualified person with written certification.

CONSEQUENCES OF NON-COMPLIANCE

- Industrial accidents resulting in fatal and severe injuries as well as irreversible physical damage.
- Criminal prosecution with custodial sentence.

Figure 44 – Operation Instructions – Rope Access Techniques

Appendix B.

Operating Instruction for the Use of FA, PPE, Fall Prevention System

OPERATING INSTRUCTIONS

For the Use of Fall Arrest
Personal Protection Equipment (PPE) and
Fall Prevention Equipment

DANGERS TO HUMAN BEINGS AND THE ENVIRONMENT

- Danger due to falling
- Danger due to impact during fall
- Danger due to impact onto objects
- Danger due to suspension trauma/orthostatic shock
- Danger due to failing anchorage points
- Danger due to opening connectors
- Danger due to damaged PPE
- Danger due to faulty operation of PPE
- Danger due to failing equipment

SAFETY PROCEDURES AND CODE OF CONDUCT

- Users must be trained in theory and in practice in the safe use of fall arrest PPE.
- Users must be trained in the theory and practice of safe rescue from fall arrest PPE.
- The training must be repeated when necessary, but at least once a year.
- Every user must be trained in first aid and have mastered the necessary emergency and rescue procedures.
- The use of fall arrest PPE must be directed by a qualified supervisor.
- At least two trained and equipped users must be within calling distance and in visual contact (Emergency & Rescue).
- Subject-related risk identification must take place prior to the use of fall arrest PPE.
- The appropriate fall arrest PPE must be selected on the basis of the risk identification.
- Falls in the fall arrest PPE must be prevented by taking appropriate measures (e.g. holding rope).
- In the event of a fall in the fall arrest PPE, the distance of the fall must be kept as short as possible.
- Emergency and rescue measures must be planned in accordance with the risk identification.
- The rescue of an immobilised person from PPE must take place as a matter of urgency.
- All persons must constantly remain safely secured when working at height.
- Only use appropriate equipment that is safe to use (Checking before/after and during use).
- Prior to use, visually check the fall arrest PPE and check its safe and reliable operation.
- The fall arrest PPE must only be used in accordance with the safety rules and the user instructions.
- Any modifications to the fall arrest PPE by the user are strictly forbidden.
- The fall arrest PPE must not be used for any other purposes.
- Only select sufficiently load-bearing and robust anchorage points (min. 10 kN).
- When using fall arrest systems, ensure an unobstructed falling distance (approx. 2-7m).
- Take into account the risk of the connector in the event of a potential fall over an edge in the PPE.
- Ensure compliance with the health and safety regulations as required by law.

CONDUCT IN THE EVENT OF FAILURES

- Fall arrest PPE must only be used when the emergency and rescue procedures have been ensured.
- Damaged equipment (wear and tear/fall strain/loss of functionality) must immediately be removed from service.
- Every safety-relevant incident must immediately be reported to the supervisor.
- In the event of hazardous weather conditions, work must be halted immediately.

ACCIDENTS, FIRST AID

☎ Emergency Phone No:........WHO/WHAT/WHERE/HOW MANY/WAIT

- All work must be halted immediately.
- Stay calm/Speak to the injured/Assess the situation/Check for danger and plan measures.
- Make an emergency call: Who/What/Where/How many/Which, give exact description of the location and appoint a guide.
- Request the immobilised person to lessen the strain (holding rope)/to move actively (activate the muscle pump).
- The rescue must be launched immediately, taking into account the situation.
- The rescue from the PPE must be launched immediately, taking into account the situation.
- After reaching the injured party, perform first aid and take further measures in accordance with the person's condition.
- Position conscious persons in the harness in a half-sitting/squatting or crouching position.
- Position unconscious persons in the recovery position and monitor vital body functions.

INSPECTION - MAINTENANCE – DISPOSAL

- The equipment must be stored in accordance with the manufacturer's instructions, away from harmful effects.
- Damaged, contaminated and unusable equipment must be removed from service immediately.
- The equipment must be checked by the user before, during and after use.
- The equipment must be checked once yearly by a specialist/qualified person with written certification.

CONSEQUENCES OF NON-COMPLIANCE

- Industrial accidents resulting in fatal and severe injuries as well as irreversible physical damage.
- Criminal prosecution with custodial sentence.

Figure 45 – Operation Instructions – FA, PPE, Fall Prevention System

Appendix C.

Operating Instruction for the Rescue from Fall Arrest System

OPERATING INSTRUCTIONS
for Rescue from Fall Arrest System

DANGERS TO HUMAN BEINGS AND THE ENVIRONMENT

- Danger due to falling by the rescuer
- Danger due to a potential fall by the person to be rescued
- Danger due to stress and panic in emergency situations
- Danger due to prolonged suspension in the PPE
- Danger due to suspension trauma/orthostatic shock
- Danger due to opening connectors
- Danger due to damaged rescue PPE
- Danger due to faulty operation of rescue PPE
- Danger due to failing equipment
- Danger due to failing anchorage points

SAFETY PROCEDURES AND CODE OF CONDUCT

- Rescue from the fall arrest PPE must take place as quickly and as safely as possible.
- The danger to the rescuer must be taken into account and must be kept to a minimum.
- Request the immobilised person to lessen the strain (holding rope)/to move actively (activate the muscle pump).
- The emergency call must be made instantly, and if required, request special rescue forces (rescue from heights).
- The rescue of an immobilised person from PPE must take place as a matter of urgency.
- The rescue must take place in the nearest possible safe location accessible to the rescue service.
- Additional injuries (secondary injuries) to the immobilised person must be avoided.
- Users must be trained in the theory and practice of safe use of the fall arrest PPE.
- The training must be repeated when necessary, but at least once a year.
- Every user must be trained in first aid and have mastered the necessary emergency and rescue procedures.
- Prior to the rescue, the rescuer must assess the dangers present.
- For each location, the necessary emergency and rescue measures must be planned in accordance with the risk identification .
- The appropriate rescue PPE must be ready for use in accordance with the emergency and rescue plans.
- All persons must constantly remain safely secured when working at heights.
- Only use appropriate equipment that is safe to use (Checking before/after and during use).
- Prior to use, visually check the fall arrest PPE and check its safe and reliable operation.
- The rescue PPE must only be used in accordance with the safety rules and the user instructions.
- Any modifications to the fall arrest PPE by the user are strictly forbidden.
- The human rescue PPE must not be used for any other purposes.
- Only select sufficiently load-bearing and robust anchorage points (min. 10 kN).
- Take into account potential damage to the rescue PPE by sharp edges.
- Ensure compliance with the health and safety regulations as required by law.

CONDUCT IN THE EVENT OF FAILURES

- In the event of excessive personal risk to the rescuer, wait for the professional rescue services.
- Damaged rescue PPE (wear and tear/fall strain/loss of operation) must be taken out of service immediately.
- Every safety-relevant incident must immediately be reported to the supervisor.
- In the event of hazardous weather conditions, work must be halted immediately.

ACCIDENTS, FIRST AID

☎ Emergency Phone No:........WHO/WHAT/WHERE/HOW MANY/WAIT

- All work must be halted immediately.
- Stay calm/Speak to the injured/Assess the situation/Check for danger and plan measures.
- Make an emergency call: Who/What/Where/How many/Which, give exact description of the location and appoint a guide.
- Ask the immobilised person to lessen the strain (holding rope)/to move actively (activate muscle pump).
- The rescue must be launched immediately, taking into account the situation.
- The rescue from the PPE must be launched immediately, taking into account the situation.
- After reaching the injured party, perform first aid and take further measures in accordance with the person's condition.
- Position conscious persons in the harness in a half-sitting/squatting or crouching position.
- Position unconscious persons in the recovery position and monitor vital body functions.

INSPECTIONS- MAINTENANCE – DISPOSAL

- The equipment must be stored in accordance with the manufacturer's instructions, away from harmful effects.
- Damaged, contaminated and unusable equipment must be removed from service immediately.
- The equipment must be checked by the user before, during and after use.
- The PPE must be checked once yearly by a specialist/qualified person with written certification.

CONSEQUENCES OF NON-COMPLIANCE

- Industrial accidents resulting in fatal and severe injuries as well as irreversible physical damage.
- Criminal prosecution with custodial sentence.

Figure 46 – Operation Instructions – Rescue from Fall Arrest System

Appendix D.

Operating Instruction for Evacuation from WTGs

OPERATING INSTRUCTIONS
For Evacuation from WTGs using PPE

DANGERS TO HUMAN BEINGS AND THE ENVIRONMENT

- Danger due to falls
- Danger due to stress and panic in emergency situations
- Danger due to prolonged suspension in the PPE
- Danger due to suspension trauma/orthostatic shock
- Danger due to time delay during the evacuation
- Danger due to opening connectors
- Danger due to damaged rescue PPE
- Danger due to faulty operation of rescue PPE
- Danger due to failing equipment
- Danger due to failing anchorage points

SAFETY PROCEDURES AND CODE OF CONDUCT

- Rescue PPE is used if the WTG cannot be evacuated via the ladder route.
- Fire/smoke present potential dangers.
- In the event of danger, the WTG must be evacuated immediately.
- Avoid inhaling any smoke
- Only attempt fire-fighting to ensure your own safety.
- During fire-fighting attempts, a secure escape route takes priority over material assets.
- If smoke is travelling upwards in the tower, do not walk down into the smoke
- The emergency call must be made instantly, and if necessary request special rescue services (rescue from heights).
- Every time the WTG is accessed, evacuation by rescue equipment in the nacelle must be ensured.
- If there is no rescue equipment available in the nacelle, take the rescue equipment from the vehicle.
- In the case of emergency, the rescue equipment must be secured to a suitable anchorage point using an anchorage sling.
- The following points are possible depending on the installation:
  - Crane rail over the floor hatch (for nacelles with floor hatch).
  - Anchorage point on the nacelle roof (for nacelles without floor hatch)
  - Weather mast on the nacelle roof (Exceptional case, e.g. with lattice mast).
- Basically, use only the installation-specific points (Emergency and rescue plan relevant to the installation).
- Users must be trained in the theory and practice of safe use of fall arrest PPE.
- Refresher training must be given when necessary, but at least once yearly.
- Every user must be trained in first aid and have mastered the necessary emergency and rescue procedures.
- All persons must constantly remain safely secured when working at heights.
- Only use appropriate equipment that is safe to operate (Inspection before/after and during use).
- Prior to use, visually check the fall arrest PPE for safe and reliable operation.
- Only use the rescue PPE in accordance with the safety rules and the user instructions.
- Any modifications to the rescue PPE by the user are strictly forbidden.
- The human rescue PPE must not be used for any other purposes.
- Only select sufficiently load-bearing and robust anchorage points (min. 10 kN).
- Take into account potential damage to the rescue PPE by sharp edges.
- Ensure compliance with the relevant health and safety regulations as required by law.

CONDUCT IN THE EVENT OF FAILURES

- In the event of excessive personal risk to the rescuer, wait for the professional rescue services.
- Damaged equipment (wear and tear/fall strain/loss of operation) must be taken out of service immediately.
- Every safety-relevant incident must immediately be reported to the supervisor.
- In the event of hazardous weather conditions, work must be halted immediately.

ACCIDENTS, FIRST AID

☎ Emergency Phone No:.... 112 WHO/WHAT/WHERE/HOW MANY/WAIT

- Stay calm/Speak to the injured/Assess the situation/Check for danger and plan measures.
- Make an emergency call: Who/What/Where/How many/Which, give exact description of the location and appoint a guide.
- Ask the immobilised person to lessen the strain (holding rope) and to move actively (activate muscle pump).
- The rescue from the PPE must be launched immediately, taking into account the situation.
- After reaching the injured party, perform first aid and take further measures in accordance with the person's condition.
- Position conscious persons suspended in the harness in a half-sitting/squatting or crouching position.
- Position unconscious persons in the recovery position and monitor vital body functions.

INSPECTIONS - MAINTENANCE – DISPOSAL

- The equipment must be stored in accordance with the manufacturer's instructions, away from harmful effects.
- Damaged, contaminated and unusable equipment must be removed from service immediately.
- The equipment must be checked by the user before, during and after use.
- The PPE must be checked when necessary, but at least once yearly by a specialist/qualified person with written certification.

CONSEQUENCES OF NON-COMPLIANCE

- Industrial accidents resulting in fatal and severe injuries as well as irreversible physical damage.
- Criminal prosecution with custodial sentence.

Figure 47 – Operation Instructions – Evacuation from WTGs

Appendix E.

Risk Identification for WTG Inspections

1 Risk Group: Risk due to Lack of Organization

1.1 Risk: Training

1.2 Risk: Workplace-related operating instructions

1.3 Risk: Coordination

1.4 Risk: Working under Increased Risk Profile

1.5 Risk: Use of Personal Protection Equipment

1.6 Risk: First Aid systems

1.7 Risk: Emergency and rescue plan

1.8 Risk: Hygiene

1.9 Risk: Organising HSE at Work

2 Risk Group: Risk due to Workplace Design

2.1 Risk: Work areas

2.2 Risk: Roadways or offshore transfer

2.3 Risk: Falling on the flat, slipping, tripping, sprains, stumbling

2.4. Risk: Falling

2.5. Risk: Confined spaces

3 Risk Group: Risk due to Non-compliance with Ergonomic Principles

3.1 Risk: Heavy physical work

3.2 Risk: Lighting

3.3 Risk: Weather, weather conditions, climate

3.4 Risk: Lifting and carrying

4 Risk Group: Mechanical Risk

4.1 Risk: Unguarded machine parts

4.2 Risk: Parts with dangerous surfaces

4.3 Risk: Means of transport

4.4 Risk: Uncontrolled moving parts

5 Risk Group: Electrical Risk

5.1 Risk: Basic risk

5.2 Risk: Chock currents

5.3 Risk: Arcing

6 Risk Group: Risk from Substances

6.1 Risk: Harmful effects on health caused by gases, vapours, aerosols, liquid and solid substances

6.2 Risk: Risk from working in contaminated areas

6.3 Risk: Effects harmful effects to the skin

7 Risk Group: Risk due to Fires/Explosions

7.1 Risk: Fire hazard due to solids, liquids and gases

7.2 Risk: Hazards due to explosive atmospheres

8 Risk Group: Risk due to Physical Impact

8.1 Risk: Noise

8.2 Risk: Vibration

8.3 Risk: Electromagnet fields

9 Risk Group: Other Potential Risks and Harmful Effects

9.1 Risk: Psychological strain

9.2 Risk: Responsibility, room for manoeuvre

10 Risk Group: Rescue and Emergency Procedures

10.1 Risk: Suspension trauma

10.2 Risk: No rescue ensured

11 Risk Group: Risk due to WTG Malfunction

11.1 Risk: Faulty operation of the WTG

11.2 Risk: Movement of the rotor

11.3 Risk: Movement of the nacelle

11.4 Risk: Movement of the rotor blade (pitching)

11.5 Risk: Failing anchorage points within nacelle roof area

Risk Matrix							
Probability (P)		Risk Factor (RF)					
Very high	5	5	10	15	20	25	
High	4	4	8	12	16	20	
Medium	3	3	6	9	12	15	
Low	2	2	4	6	8	10	
Minimal	1	1	2	3	4	5	
		1	2	3	4	5	
		Insignificant	Low critical	Critical	Very Critical	Catastrophic	
		Insignificant Damage	Minor Damage	Significant Damage	Serious Damage	The Most Serious Damage/Death	
		Effect (E)					

Risk factor	Risk	Safety Measures	Need for Action/Checking
	High	Only with effective safety measures	Immediate need for action/Permanent checking
	Medium	Only with appropriate safety measures	High need for action/Checking
	Low	Safety measures recommended	Low need for action

12 Risk Group: Risk due to Offshore Works

12.1 Risk: People unable to leave offshore WTG, OSP or Met-Mast

12.2 Risk: No effective chain of rescue procedures

12.3 Risk: No/delayed emergency medical first aid

12.4 Risk: No effective First Aid procedures

12.5 Risk: Secondary damage

12.6 Risk: Delayed rescue from offshore WTG, OSP or Met-Mast

12.7 Risk: Hypothermia

12.8 Risk: Drowning

12.9 Risk: Lack of emergency equipment

12.10 Risk: Lack of/insufficient training/instruction

The following risk register covers most significant safety risks. It can be used when carrying out risk identification and risk assessment sessions involving inspections and other works at for wind farm installations.

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
1 Risk Group: Risk due to Lack of Organization						
1.1 Risk: Training Insufficient theoretical or practical training related to the risk/activity.				Ensure sufficient theoretical and practical staff training related to the risk. Refresher courses, when required, e.g.: - Safety-relevant incidents. - Work under increased risk profile - New risks identified.	User training. Operating instructions. Training by competent person. All training courses to be documented. Qualifying the workers for the activity. Provide special training. Regularly teach safety-relevant knowledge, e.g. rescue and emergency procedures.	Theoretical and practical training courses concerning all safety-relevant activities.

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
1.2 Risk: Workplace-related Operating Instructions No/insufficient operating instructions for safety-relevant activities.				The operating instructions must document the necessary safety measures to prevent/minimize risks and harmful effects. Operating instructions must be compiled for, for example: - Servicing/maintenance. - Particular risky activities, e.g. risk of falls/offshore/rescue and emergency procedures.	Compiling of operating instructions for all safety-relevant activities: - In understandable language. - Simple expressions. - To be issued to the workers. - To be displayed at suitable locations. User training on the basic principles of the operating instructions. Checking by supervisors.	Compiling of operating instructions by professional personnel qualified in HSE.

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
1.3 Risk: Coordination Risk due to lack of and/or insufficient coordination of work and work processes, e.g.: - Mutual risk. - Lack of authority to issue orders. - Uncoordinated processes.				For all work and in particular for work which potentially carries mutual risk, appropriate safety measures must be taken: - Careful planning with documented processes. - Clear managerial structure with clearly defined authority. - Determine and document responsibilities and decision-making powers. - If necessary, appoint a suitably qualified supervisor. - Report start and completion of work; allocation of personnel. - Briefing everyone on the safety measures and local information. - Compliance with all safety-relevant instructions, e.g. operating instructions. - Appropriate Organization of sites and work processes.	Sufficient consideration for all the safety-relevant issues when planning projects and allocating resources: - Document processes. - Determine qualified managerial personnel. - Define areas of responsibility. - Determine supervisors. - Ensure coordination. - Allocate qualified workers. - Clearly define duties both in time and space. - Train personnel. - Assess effectiveness of the safety measures and adjust if necessary.	Safety-relevant issues must be taken into account in inspection planning at an early stage.

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
1.4 Risk: Working under Increased Risk Profile: Performing work under increased risk without ensuring effective safety measures.				Risk profile may increase through changes in circumstances such as working in more exposed locations. Working alone under increased risk and high risk is strictly forbidden. Examples of increased risk activities: - Work involving risk of falling. - Work in confined spaces. - Working with naked flames. - Working with cleaning products and solvents. - Working with hydraulic equipment. - Working in hazardous weather conditions. - Spending time in the risk area (Test runs). - Crane work. - Offshore work. Also see the relevant points in this risk identification document.	In the case of work under increased risk, all relevant safety measures must be complied with: - Perform specific risk identification. - Compile operating instructions. - Appoint a qualified supervisor for the work. - Select qualified workers. - Use of the necessary PPE fit for the purpose. - Use of reliable and safe work equipment. - Determine the necessary safety parameters, e.g. weather. - Ensure rescue and emergency measures. - Check effectiveness of all safety measures. - Document procedures and staff training.	Perform specific, task-related risk identification. Operating instructions - risk of falling. Operating instructions - confined spaces.

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
1.5 Risk: Use of Personal Protection Equipment -The necessary PPE is not used in accordance with its intended purpose or it is not checked or safe to use.				The use of PPE is necessary when engineering measures do not ensure sufficient protection. The necessary PPE must be selected on the basis of the risk identification, and the safety benefits of the PPE must be assessed. When using category 3 PPE, it is imperative that the users are instructed and trained in its use both in theory and in practice.	Selection of appropriate PPE in accordance with the risk identification. Training of workers in the appropriate use of the PPE. Monitoring/inspection of the PPE by the users/supervisors. Inspection of the PPE by a specialist/qualified person. Immediately replace the PPE in the event of damage/loss of functionality. Fall arrest PPE and rescue PPE must be documented accordingly.	Ensure full compliance with the manufacturer's operating instructions. Operating instructions - fall arrest PPE.

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
1.6 Risk: First Aid Systems: Lack of or delayed First Aid on site.				Ensure a correctly operating chain of rescue procedures for each site. Increased risk due to exposed/difficult to access site. Determine appropriate rescue and emergency procedures for each site. Work must only be performed when the chain of rescue procedures has been ensured. This is the supervisor's responsibility.	All workers must be trained in First Aid (First Aider). All workers must be trained in the rescue and emergency procedures. Rescue and emergency equipment must be available on site and ready for use. It must at all times be possible to make an emergency call. Offshore work requires special safety measures. Please also refer to the Offshore rescue and emergency programme.	Please also refer to the Offshore rescue and emergency programme. Operating instructions – Rescue and emergency procedures.

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
1.7 Risk: Emergency and Rescue Plan - Lack of/delayed assistance due to lack of an alert and rescue plan.				The following points must be ensured by qualified alarm and rescue planning: - Clear identification of the WTG. - Agreement with rescue services. - Access for rescue services. - Location maps. - Escape/rescue routes. - Escape/rescue procedure. - Emergency call system. - Procedures in case of physical injury. - Fire procedures. - Procedures in case of dangerous failures. - Claims procedures.	Compiling and implementation of the rescue and emergency plan. Escape and rescue plan stipulating: - Conduct in emergencies/fires. - Location of the escape/rescue routes. - Accessibility of the escape routes. - Location of the rescue equipment. - Anchorage points. - Location of the available fire extinguishers. - Location of the first aid kit. - Emergency call arrangement. - Signpost escape- routes in the WTG/OSP, onshore substation or the building site. Compile appropriate operating instructions. Training and instruction of workers. Rescue exercises. Agreement with rescue services.	Please also refer to the Offshore rescue and emergency programme. Operating instructions – Rescue and emergency procedures.

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
1.8 Risk: Hygiene. Health problems due to lack of hygiene.				Hygiene procedures to be stipulated in operating instructions. For the use of hazardous substances, it is imperative to refer to the safety data sheets. Ensure skin protection. Ensure protective clothing. Prevent risk during food consumption. Ensure safe disposal of substances.	Provision of safety equipment. Compile operating instructions. Staff training. Supervision by manager.	
1.9 Risk: Organising HSE at Work. Risk due to lack of/ineffective Organization of Health & Safety at Work.				Organization al procedures for HSE at Work: - Clear arrangement regarding duties, responsibilities and decision-making powers. - Appointment of qualified supervisors.	Appointment of: - Safety specialist. - Company doctor. - Safety representatives. - First Aider. - Rescue officers. Organization of H&S meetings in accordance with H&S legislation. Perform preventive industrial medical examinations, organised with the company doctor.	

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
2 Risk Group: Risk due to Workplace Design						
2.1 Risk: Work Areas. Risk due to work environment/work areas, lack of escape routes.				Ensure accessibility to work areas. Ensure escape routes. Close floor hatches. Secure hazardous locations, e.g. areas with risk of falling. Take technical safety measures. Use appropriate PPE. Take air readings in confined spaces, e.g. danger of lack of oxygen. For work in locked electrical operating rooms, arrange access authorisation. Set up safe rooms for emergency purposes.	Compile operating instructions for hazardous areas, e.g. hub access. Staff training. Define and implement safety measures. Provide appropriate PPE.	Please also refer to the Offshore rescue and emergency programme. Operating instructions – hub access.

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
2.2 Risk: Roadways or offshore transfer. Risk due to the condition of the roads or offshore conditions affecting safe offshore transfer and man-landing on WTG, OSP or Met-Mast.				Roadways must be designed and calculated in such a way, and must be maintained in this condition, so that they are safe to access and travel upon in accordance with their purpose. Offshore transfer must only be authorised when the weather conditions are conducive to safe offshore transfer and man-landing on WTG, OSP or Met-Mast. When implementing special access measures, it is imperative that appropriate risk identification be carried out. Check and release safety equipment. Keep roadways clean and clear. Signpost escape-routes and keep them clear. Introduce special access techniques. Check and signpost anchorage points.	Check and ensure the safety of the roadways. Check wind speed, wave height and currents. Follow maritime rules for safe offshore transfer. Signpost the roadways. Seal off dangerous areas. Consider modifications due to work in progress, e.g. on building sites. Safety equipment must only be used subject to approval. Introduce appropriate PPE. Special safety measures for temporary roadways. Only use approved and signposted anchorage points. Ensure escape routes.	Please also refer to the Risk Identification for the rope access technique.

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
2.3 Risk: Falling on the flat, slipping, tripping, sprains, stumbling - Danger of falling or tripping due to various factors.				Reduce risk by providing suitable roadways. Keep roadways free from obstacles. Remove stumbling or falling hazards. Signpost hazardous areas. Prevent risk caused by left materials. Collect liquids in containers.	Identify appropriate roadways. Staff training. Introduce appropriate anti-slip protective shoes (above ankle height). Take account of weather impact. Move carefully in areas of risk.	

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
2.4 Risk: Falling - Danger of falling				Eliminate the risk of falling by taking engineering safety measures. Keep hatches closed. Reduce the risk of falls by using fall arrest PPE. Define the securing procedure. Define the anchorage points. Only use vertical fixed rail fall arrest systems after documented approval. Use of safe equipment when working at heights. Wear appropriate protection equipment when outside of the WTG on Offshore locations where there is risk of falling into the water.	Identify areas where there is a risk of falling. Define the safety procedures. Compile operating instructions. Staff training. Provide appropriate PPE. Check fall arrest PPE prior to use. Only use defined anchorage points. Ensure emergency and rescue procedures. Only use qualified personnel.	Operating instructions - fall arrest PPE. Operating instructions - rescue from fall arrest PPE.

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
2.5 Risk: Confined Spaces - Risks due to working in confined spaces. Confined spaces on a WTG can be: - Spinner/hub/rotor blades. - Nacelle/areas below the entrance level. Risks in confined spaces: - Confined position/physical strain/contact injuries. - Mechanical risk. - Lack of oxygen/ hazardous substances. - Complicated/delayed rescue.				Select appropriate personnel. Preventive industrial medical examinations. Perform specific risk identification. Define safety procedures. Immobilise WTG. Block rotor. Establish zero pressure condition on hydraulic equipment. Ensure communication. Define appropriate team size. Ensure rescue.	Compile operating instructions. Define safety procedures. Staff training. Define and use appropriate PPE. Ensure rescue.	Operating instructions - confined spaces. Operating instructions - hub access.
3 Risk Group: Risk due to Non-compliance with Ergonomic Findings						

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
3.1. Risk: Heavy Physical Work - Risk of injury and strain on health due to physical strain.				Avoid heavy physical work. Use ergonomic tools. Reduce the time of introduction. Select appropriate personnel. Use ergonomic work procedures.	Staff training. Define appropriate safety procedures.	
3.2 Risk: Lighting - Risk due to a lack of/impaired lighting.				Ensure sufficient lighting of roadways and workplaces. Ensure security lighting. Carry battery powered lighting.	Sufficient consideration to lighting at planning stage. Check operation of security lighting. Independent light source. Carry lighting (head lamp). Interrupt work when insufficient lighting.	

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
3.3 Risk: Weather, Weather Conditions, Climate. Risk due to weather conditions.				Only perform work in appropriate weather conditions. Use protective clothing. In high temperatures, ensure sufficient breaks and intake of fluids. Check weather forecast when planning work.	Define permitted weather parameters in operating instructions. Appropriate work planning. Use appropriate weather-resistant protective clothing. Halt work in hazardous weather. Leave danger area immediately in bad weather. In dangerous weather conditions, inform everyone in danger area.	
3.4 Risk: Lifting and Carrying. Risk due to manual lifting and carrying.				Reduce manual handling of loads. Use ergonomic lifting equipment/tools. Comply with loading regulations. Reduce loads.	Staff training. Provide suitable lifting equipment/tools.	
4 Risk Group: Mechanical Risk						

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
4.1. Risk: Unguarded Machine Parts. Risk due to unguarded machine parts:- pinching/jamming/pulling in.				Cover rotating parts. Protect feeding-in areas. Immobilise WTG.	Compile operating instructions with appropriate safety measures. Staff training. Ensure engineering safety measures.	
4.2 Risk: Parts with Dangerous Surfaces - Component parts with dangerous surfaces: Sharp edges, frayed metal rope, hot surfaces.				Provide edge protection. Use safe tooling and equipment. Adopt safety measures.	Staff training. Use PPE.	

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
4.3. Risk: Means of Lifting - Risk due to crane and winching work.				Use safe equipment (documented inspection). Comply with regulatory Safe Working Load (SWL) and Working Load Limit (WLL) requirements. Comply with loading and weight regulations. Secure loads safely. Do not stay in danger area. Ensure constant communication. Specific risk identification for use of PAM. Secure loads safely against inadvertent loosening. Avoid pendulum motion. Use additional guide ropes.	Compile operating instructions for means of transport. Staff training. Use only qualified workers (slinger/crane drivers). Define the communication process. Secure loads as instructed. Use appropriate PPE.	

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
4.4 Risk: Uncontrolled Moving Parts - Risk due to uncontrolled moving parts.				- Uncontrolled moving machine parts: switch off WTG before entering. - Block rotor upon hub access. Secure loosely fixed parts against tipping over. Secure components with guide ropes against wind impact. Evacuate danger areas. Secure equipment/tooling.	Compile operating instructions. Staff training. Define work processes. Define danger areas.	
5 Risk Group: Electrical Risk						
5.1 Risk: Basic Risks - Risk in the WTG, due to electrical control room. Specific risk: - Medium voltage equipment. - Transformers. - Low voltage distribution equipment.				The risks due to the electrical equipment in control rooms depend on the level of contact and arcing protection as well as on operating safety. Only qualified workers have authorised access to dangerous equipment areas. Operating processes and control panel operations only by qualified electricians or electrical engineers on the basis of appropriate training.	Use qualified workers: - Specialist electrician. - Electrical engineer. Use of workers authorised for control panel operations. Definition of control panel operations in company manual.	

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
5.2 Risk: Shock Currents - Risk due to shock currents.				Full contact safety is a fundamental requirement and must be implemented in the WTG, OSP, onshore substation and on transmission cables. If full safety cannot be guaranteed, then at least Safety by Distance or Guarding devices must be ensured. Operating processes require at least partial contact safety in accordance with DIN EN 50274.	Compile operating instructions. Use qualified workers: - Specialist electrician. - Electrical engineer. Use of workers authorised for control panel operations. Define control panel operations in company manual. Design a safe work area ensuring compliance with the five safety rules: - Switch off. - Secure against accidental switching on. - Check lack of voltage. - Earth and short-circuit. - Cover or encase neighbouring live parts.	

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
5.3 Risk: Arching - Risk due to arcing.				To prevent risk of arcing, procedures must already be in place at the time of installation of WTGs, OSP or onshore substation and during operation of electrical equipment, which eliminate arc discharges (e.g. insulation) or reduce the impact of discharged arcing (e.g. arcing current and/or time limitations or arc proof covers).	Switch off when working in dangerous areas. Compile operating instructions. Use qualified workers and Specialist electrician. Use of workers authorised for control panel operations. Define control panel operations in company manual. Set up a safe work area ensuring compliance with the five safety rules: - Switch off. - Secure against accidental switching on. - Check lack of voltage. - Earth and short-circuit. - Cover or encase neighbouring live parts. Use of appropriate PPE	
6 Risk Group: Risk from Substances						

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
6.1 Risk: Harmful effects on health caused by Gases, Vapours, Aerosols, Liquid and Solid Substances - Risk of harm/damage due to hazardous substances.				Comply with safety data sheets. Implement specific risk identification. Define appropriate safety measures. Involve company doctor and external medical facilities in the Risk Identification. Ensure special First Aid procedures. Comply with hazardous substance ordinance. Avoid industrial substances harmful to health. Monitor concentration of hazardous substance.	Compile operating instructions with the aid of the safety data sheets. Staff training. Use appropriate PPE: - Protective gloves. - Protective goggles. - Protective clothing. - Protective breathing mask. Ensure sufficient ventilation/extraction.	
6.2 Risk: Risk from Working in Contaminated Areas - Health risk due to working in contaminated areas				Perform specific risk identification. Measure concentration of hazardous substance. Define safety procedures.	Compile operating instructions. Staff training. Use appropriate PPE. Avoid/reduce contamination.	

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
6.3 Risk: Effects Harmful to the Skin - Health risk due to effects harmful to the skin, e.g. chemical impact.				Involve company doctor or external medical specialist to define procedures. Prevent skin contamination. Assess the harmful effect.	Define and use skin protection plan. Staff training. Use appropriate PPE.	
7 Risk Group: Risk due to Fires/Explosions						
7.1 Risk: Fire Hazard due to Solids, Liquids and Gases				Reduce fire load. Prevent sources of ignition. Fire-based work must be regulated by permits or working/operating instructions.	Ensure fire extinguishing equipment is in position and ready for use. Train workers in fire-fighting. Compile operating instructions.	
7.2 Risk: Hazards due to explosive atmospheres - Risk of explosions, e.g. in soldering and cutting work.				Identify risk. Define safety measures. Perform specific risk identification. Compile explosion safety document (Hazardous Substance Ordinance/Industrial Safety Ordinance).	Define and document safety procedures in a soldering permit. Select experienced/responsible people for the work. Use tools in perfect condition. Wear high fire-resistant protective clothing. Implement fire stations as fire service with appropriate fire extinguishers.	
8 Risk Group: Risk due to Physical Impact						

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
8.1 Risk: Noise - Health risk due to noise.				Risk due to equipment noise. Risk due to noise intensive tooling. Implement noise readings. Arrange preventive examinations in accordance with local legislation.	Minimize noise load. Use appropriate PPE (hearing protection).	
8.2 Risk: Vibration - Risk due to vibration.				Use low-vibration tooling. Reduce exposure. Involve company doctor and external medical specialist to assess maximum daily use.	Compile operating instructions. Staff training. Provide PPE.	
8.3 Risk: Electromagnetic Fields - Risk due to electromagnetic fields.				For example, working close to radio masts. Keep a safe distance. Request information from mast operator. Maintain the appropriate safe distance for exposure range 1 in accordance with local regulations. If that is not possible, have the transmission equipment switched off.	Staff training. Signpost danger areas.	
9 Risk Group: Other Potential Risks and Harmful Effects						

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
9.1 Risk: Physiological Strain - Risk due to psychological strain, e.g. stress, deadlines.				Avoid deadline pressure. Ensure sufficient planning. Include some spare time. Avoid overloading workers. Use qualified personnel in the appropriate position.	Special responsibility in project management and project planning.	
9.2 Risk: Risk due to undefined activity responsibility.				When several workers work together, a supervisor must be appointed. The supervisor must be suitably qualified for this duty.	Staff training. Compile operating instructions.	
10 Risk Group Rescue and Emergency procedures						
10.1 Risk: Suspension Trauma - Person suspended and immobilised in the PPE due to injury/acute illness.				Immediate rescue to the nearest safe area. Lone working is not permitted and team of minimum two people is required.	User training. Supervision by supervisor. Safety ensured through Organization al procedures.	Training in special First Aid procedures must be given.
10.2 Risk: Lack of a rescue plan -The rescue of an immobilised person is not ensured. Rescue from the safety harness must take place as soon as possible, within max. 20 minutes				Every member of the team must have mastered the necessary rescue procedures. Implement emergency and rescue planning for every assignment.	User training. Supervision by supervisor. Safety ensured by Organization al procedures.	Ensure regular training in rescue techniques.

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
11 Risk Group: Risk due to WTG Malfunction						
11.1 Risk: Risk due to malfunction of WTG.				Training by manufacturer. Maintenance technician from the operator/manufacturer on site. Stop WTG. Deactivate remote surveillance (maintenance mode). Activate emergency stop.	User training. Supervision by supervisor. Safety ensured by Organization al procedures.	Comply with manufacturer’s safety instructions.
11.2 Risk: Movement of Rotor - Risk due to rotor movement when working outside/on the blade.				Rotor must be blocked/Set rotor stoppage.	User training. Supervision by supervisor. Safety ensured by Organization al procedures.	Comply with manufacturer’s safety instructions.
11.3 Risk: Movement of the Nacelle - Risk due to nacelle movement.				Deactivate wind direction.	User training. Supervision by supervisor. Safety ensured by Organization al procedures.	Comply with manufacturer’s safety instructions.
11.4 Risk: Movement of the Rotor Blade (Pitching) - Risk due to movement of the rotor blade while rope access technique workers are busy working on it.				No pitching of the blades when people are by the blade. Activate emergency stop.	User training. Supervision by supervisor. Safety ensured by Organization al procedures.	Comply with manufacturer’s safety instructions.

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
11.5 Risk: Failing Anchorage Points within Nacelle Roof Area - Risk due to insufficiently load-bearing anchorage points in nacelle roof area.				Use inspected and identified anchorage points. Select structurally sound anchorage points.	User training. Supervision by supervisor. Safety ensured by Organization al procedures.	Comply with manufacturer's safety instructions.
12 Risk Group: Risk due to Offshore Work						
12.1 Risk: People unable to leave Offshore WTG, OSP, Met-Mast, e.g. due to bad weather conditions.				Collect and check weather forecast prior to starting assignment. Only perform assignment if weather parameters permit safe transport from the OWTG. The WTG is equipped with appropriate equipment for an emergency stay.	Set up appropriate safety room. Appropriate and responsible assignment planning. Staff training.	
12.2 Risk: Ineffective chain of rescue procedures.				Only perform assignments on WTG, OSP, Met-Mast or onshore substation when chain of rescue procedures has been ensured. Communication equipment must be available and operational. All persons working on the offshore WTG, OSP and offshore Met-Mast must know procedures for emergency and communication via radio	Ensure rescue procedures. Staff training. Always carry communication equipment and have it ready for use.	Health & Safety at Work Legislation

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
				equipment.		
12.3 Risk: Lack of or delayed emergency medical first aid.				Emergency medical first aid by specialist personnel (rescue assistant/emergency doctor) must be ensured as soon as possible in the event of a medical emergency (accident/acute illness). As medical assistance by the rescue service is currently not available on the offshore WTG, Met-Mast and OSP the initial medical care and transport is performed by a qualified first aider (First Responder), with the aim of handing the patient as soon as possible to qualified emergency medical personnel (such as air rescue/Search & Rescue/DGZRS(German Maritime Search and Rescue Service). In the event of special risks or a larger number of people being present on the Offshore wind farm, it is recommended to have an emergency team of medical specialists on site.	Staff training and instruction. Use qualified personnel.	

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
12.4 Risk: Ineffective First Aid procedures.				Maintenance personnel for WTG, OSP, Met-Mast, onshore substation and transmission cables must be trained and instructed in First Aid and in the extended First Medical Assistance procedures (First Responder). This qualification must be kept up to date through regular exercises and simulated situations. The appropriate equipment must be available on the WTG, OSP, Met-Mast, onshore substation.	Staff training. Ensure appropriate equipment is kept in WTG, OSP, Met-Mast, onshore substation, where possible. If not ensure that inspectors / maintenance staff take the equipment along when going to WTG, OSP, Met-Mast, onshore substation.	
12.5 Risk: Secondary damage to the injured person/acutely ill person, e.g. due to inappropriate rescue/transport.				Ensure a patient-specific rescue and safe transport by appropriately qualified personnel and appropriate equipment. If possible, always carry the rescue stretcher horizontally. Stabilise and immobilise (spine-board) the patients prior to transport. Take in account injury patterns, e.g. suspicion of spine injuries.	Staff training. Ensure appropriate equipment is present on OWTG or carry it along.	

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
12.6 Risk: Delayed Rescue from Offshore WTG, OSP, Met-Mast.				Immediately activate chain of rescue procedures. Only perform assignments on OWTG when a chain of rescue procedures is ensured. The chain of rescue procedures must be tested.	The chain of rescue procedures must be ensured.	
12.7 Risk: Hypothermia				Risk during work outside while exposed to the elements. Risk when working near water. Take weather conditions and water temperature into consideration.	Use appropriate PPE (Anti-Exposure Suit/Immersion Suit) Compile operating instructions. Staff training.	
12.8 Risk: Drowning				Avoid working near water without taking safety measures. Implement specific risk identification. Ensure appropriate PPE. Ensure rescue procedures.	Compile operating instructions. Staff training. Use appropriate PPE. Upon evacuation by abseiling, avoid making an emergency landing onto water. Wear life jacket and survival suit.	

Risk Description / Cause	E	P	RF	Safety Measures	Implementation of Safety Measures	Comment
12.9 Risk: Lack of emergency equipment.				The necessary emergency and rescue equipment must be available on the OWTG and must be ready for use. The maintenance personnel must know the location of the equipment.	Appropriate equipment for the OWTG. Test equipment. Staff training.	
12.10 Risk: Lack of or insufficient instruction and safety training for offshore inspectors/workers.				Maintenance personnel must receive appropriate safety instruction and training. Knowledge must be kept up to date through regular training and emergency simulations.	Ensure instruction and training. Keep knowledge regularly updated.	

Appendix F.

Swiss Regulations

#	Subject	Law	Website	Content (English)
1	Accident Protection - Transportation of Oversized/ Dangerous Goods (WTG Components)	SR 814.012 Ordinance of 27 February 1991 on Protection against Major Accidents (Major Accidents Ordinance, MAO)	http://www.admin.ch/ch/e/rs/814_012/a1.html	**Translation of relevant content. Use link to access full document.** This ordinance is relevant to WTGs as regards exceptional transports. Art. 1 Purpose and scope The purpose of this Ordinance is to protect the public and the environment against serious harm or damage resulting from major accidents. It applies to: a. establishments where the threshold quantities for substances, preparations or special wastes specified in Annex 1.1 are exceeded; (...) c. railway installations where dangerous goods are transported or shipped in accordance with the Ordinance of 3 December 19965 on the Carriage of Dangerous Goods by Rail and Cableway (RSD) or the relevant international agreements; d. transit roads, as defined in the Ordinance of 6 June 19836 on Transit Roads, where dangerous goods are transported or shipped in accordance with the Ordinance of 17 April 19857 on the Carriage of Dangerous Goods by Road (SDR) or the relevant international agreements; e. the Rhine, where dangerous goods are transported or shipped in accordance with the Ordinance of 29 April 19708 on the Carriage of Dangerous Goods on the Rhine (ADNR); (...) In individual cases, the enforcement authority may make the following establishments, transport routes or pipeline installations subject to this Ordinance if, on account of their hazard potential, they could cause serious harm to the public or damage to the environment:11 a. establishments handling substances, preparations or special wastes; (...) c. transport routes outside establishments, where dangerous goods are transported or shipped in accordance with paragraph 2; (...) This Ordinance does not apply to installations and forms of

#	Subject	Law	Website	Content (English)
				transport which are subject to legislation on nuclear energy and radiological protection, insofar as the associated radiation could cause harm to the public or damage to the environment. The provisions of Article 10 EPA are directly applicable to establishments or transport routes which, in the case of exceptional events, could cause serious harm to the public or damage to the environment not arising from substances, preparations, special wastes or dangerous goods, or from genetically modified or pathogenic microorganisms. **Art. 2 Definitions** 1 An establishment comprises installations as defined in Article 7 paragraph 7 EPA which have closely related operations and are in close proximity to each other (operating area). 2 Railway installations are buildings and other fixed installations used directly for the transport or shipment of dangerous goods. They include, in particular, tracks (open or in stations), private sidings outside an operating area and shipment areas. They do not include, in particular, warehouses. 3 The hazard potential is the sum of the impacts which could arise from the quantities and properties of the substances, preparations, special wastes, microorganisms or dangerous goods in question.1 4 A major accident is an exceptional event occurring in an establishment, on a transport route or in a pipeline installation which has significant impacts: a. outside the operating area, b. on or near the transport route, c. near the pipeline installation. 5 The risk is determined by the extent of the possible harm to the public or damage to the environment resulting from major accidents and the likelihood of their occurrence. **Art. 3 General safety measures**

#	Subject	Law	Website	Content (English)
				1 The person responsible for an establishment, a transport route or a pipeline installation shall take all appropriate measures to reduce risk that are available in accordance with the state of the art of safety technology, supplemented by personal experience, and which are economically viable. These shall include measures to reduce the hazard potential, to prevent major accidents and to limit the impacts thereof. 2 When measures are selected, account shall be taken of operational and local factors which could cause major accidents, as well as actions of unauthorized persons. 3 When measures are adopted, account shall be taken in particular of the principles laid down in Annex 2. **Art. 4 Special safety measures for establishments** If the person responsible is clearly required to produce a risk report given the nature of the establishment, its hazard potential and the surrounding area, or if the need for such an assessment has been determined in accordance with Article 6, the person responsible shall, in addition to the general safety measures, adopt the special safety measures laid down in Annex 3 **Art. 5 Summary report** 1 The person responsible for an establishment must submit a summary report to the enforcement authority. It shall include: a. a concise description of the establishment, together with a general plan and information on the surrounding area; b. a list of the maximum quantities of the substances, preparations or special wastes present in the establishment which exceed the threshold quantities specified in Annex 1.1, together with the applicable threshold quantities; c. the risk assessment specified in Article 8 of the Containment Ordinance of 9 May 20123; d. documents drawn up in the preparation of any property and corporate liability insurance policies; e. details of safety measures;

#	Subject	Law	Website	Content (English)
				f. an estimate of the extent of possible harm to the public or damage to the environment resulting from major accidents. 2 The person responsible for a transport route shall submit a summary report to the enforcement authority. It shall include: a. a concise description of the structural and technical design of the transport route, together with a general plan and information on the surrounding area; b. data on the volume and structure of traffic on the transport route and accident statistics; c. details of safety measures; d. an estimate of the likelihood of a major accident causing serious harm to the public or damage to the environment. 3 The person responsible for a pipeline installation shall submit a summary report to the enforcement authority. It shall include: a. a concise description of the structural and technical design of the pipeline installation, together with a general plan and information on the surrounding area; b. data on the type, composition and physical state of the substances and preparations transported, together with the approved operating pressure and accident statistics; c. details of safety measures; d. an estimate of the likelihood of a major accident causing serious harm to the public or damage to the environment. 4 The person responsible shall update the summary report if substantial changes have occurred or relevant new knowledge becomes available. **Art. 10 Information on the transport of dangerous goods** 1 The person responsible for railway installations on which dangerous goods are transported in accordance with the RSD1 shall periodically compile and duly submit to the enforcement authority all the data on transport operations which is required to determine and evaluate the risk, such as the date of transport, the classification and volume of goods, and the place of departure and

#	Subject	Law	Website	Content (English)
				destination. 2 Any transport operator who transports dangerous goods in accordance with SDR3 shall submit the following information to the enforcement authority of the canton where he is domiciled or has his place of business: a. his name and address; b. on request, all other data on transport operations which is required to determine and evaluate the risk, such as the date of transport, the classification and volume of goods, and the place of departure and destination. 3 At the request of the Federal Office for the Environment (Federal Office)4, the Directorate of the Federal Military Administration shall ensure that the data specified in paragraph 2 is collected from the sections of the Federal Department of Defense, Civil Protection and Sport5 which transport dangerous goods in accordance with the SDR or with the Ordinance of 1 June 19836 on Military Road Traffic. 4 Any transport operator who transports dangerous goods in accordance with the ADNR7 shall submit the following information to the enforcement authority: a. his name and address; b. on request, all other data on transport operations which is required to determine and evaluate the risk, such as the date of transport, the classification and volume of goods, and the place of departure and destination.
2	Accident Prevention and Protection	SR 814.012 Ordinance of 27 February 1991 on Protection against Major Accidents	http://www.admin.ch/ch/e/rs/814_012/index.html	**Table of Content for linked document. Please use link to access full text.** Ordinance on Protection against Major Accidents (Major Accidents Ordinance, MAO) of 27 February 1991 (Status as of 1 April 2013) The Swiss Federal Council, on the basis of Article 10 paragraph 4 and Article 39 paragraph 1 of the Federal Act of 7 October 19831 on the Protection of the

#	Subject	Law	Website	Content (English)
		(Major Accidents Ordinance , MAO)		Environment (EPA) and Article 47 paragraph 1 of the Waters Protection Act of 24 January 19912,3 ordains: Section 1: General Provisions Art. 1 Purpose and scope Art. 2 Definitions Section 2: Principles of Prevention Art. 3 General safety measures Art. 4 Special safety measures for establishments Art. 5 Summary report Art. 6 Evaluation of the summary report, risk report Art. 7 Evaluation of the risk report Art. 8 Additional safety measures Art. 9 Disclosure of results of regulatory review Art. 10 Information on the transport of dangerous goods Section 3: Response to Major Accidents Art. 11 Section 4: Responsibilities of the Cantons Art. 11a Coordination with structure and land use plans Art. 12 Point of contact Art. 13 Information and alerts Art. 14 Coordination of emergency services Art. 15 Coordination of inspections of establishments Art. 16 Provision of information to the Federal Office Section 5: Responsibilities of the Confederation Art. 17 Data collection by the Federal Office Art. 18 Data concerning the import, export and transit of dangerous goods by road Art. 19 Processing of data concerning the transport of dangerous goods by road Art. 20 Information Art. 21 Expert commissions Art. 22 Guidelines Section 6: Final Provisions

#	Subject	Law	Website	Content (English)
				Art. 23 Enforcement Art. 24 Amendment of existing legislation Art. 25 Transitional provisions Art. 25a Transitional provisions relating to the amendment of 13 February 2013 Art. 26 Commencement Annexes (Only documents relevant to owners & operators of WTGs listed below. Use link to access full documents.) Annex 1 - Scope and summary report - Threshold quantities for substances, preparations or special waste - 1 ... - 2 Determination of threshold quantities - 21 Substances or preparations - 22 Special waste - 3 Substances and preparations with specified threshold quantities (list of exceptions) - Substance name - 4 Criteria for determining threshold quantities - 41 Toxicity - 42 Fire and explosion characteristics - 43 Ecotoxicity - 5 … Annex 1.2 (...) Annex 2 - Principles for the adoption of general safety measures - Establishments handling substances, preparations or special waste (...) Annex 2.3 - Transport routes (...) Annex 3

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				- Special safety measures - Establishments handling substances, preparations or special wastes (...) Annex 4 - Risk report - Establishments handling substances, preparations or special wastes - 1 Principles - 2 Basic data - 21 Establishment and surrounding area - 22 List of substances, preparations or special wastes present in each study unit - 23 Description of installations in each study unit - 24 Safety measures in each study unit - 3 Analysis for each study unit - 31 Methods - 32 Hazard potentials - 33 Main major accident scenarios - 331 Release process - 332 Effects of release - 333 Consequences for the public and the environment - 4 Conclusions - 5 Summary of the risk report (...) Annex 4.3 - Transport routes - 1 Principles - 2 Basic data - 21 Transport route and surrounding area - 22 Volume and structure of traffic and accident statistics - 23 Safety measures - 3 Analysis - 31 Methods - 32 Hazard potentials - 33 Main major accident scenarios - 4 Conclusions - 5 Summary of the risk report

#	Subject	Law	Website	Content (English)
				(...) AS 1991 748 1 SR 814.01 2 SR 814.20 3 Amended by No I of the Ordinance of 13 Feb. 2013, in force since 1 April 2013 (AS 2013 749).
3	Accident Prevention and Protection	Swiss Regulation (SR) on Accident Prevention and Protection	http://www.admin.ch/opc/de/classified-compilation/81.html#819	**Only passages relevant to owners & operators of WTGs listed below. Use link to access full document.** List of Swiss Regulations (SR) on Accident Prevention and Protection ("Unfallbekämpfung") with specific relevance to the owner / operator of wind power plants. **819 Emergency Response** 819.1 Product Safety → 930.11 → 930 111 → 930.111.5 819.121 Ordinance of 20 November 2002 concerning the safety of pressure equipment (Pressure Equipment Directive) 819 122 Regulation of 20 November 2002 concerning the safety of simple pressure vessels (Pressure Vessel) 819.13 Regulation of 23 June 1999 on the safety of elevators (elevator Regulation) 819.14 Order of 2 April 2008 on the safety of machinery (Machinery Directive , MaschV) 819 814 sound effects and protection against laser beams → 814.49 819 832 prevention of industrial accidents

#	Subject	Law	Website	Content (English)
				→ 832.31
4	Accident Prevention and Protection	SR 814.012 Ordinance of 27 February 1991 on Protection against Major Accidents (Major Accidents Ordinance, MAO)	http://www.admin.ch/ch/e/rs/814_012/index.html	**Table of Content for relevant parts of linked document. Please use link to access full text.** Ordinance on Protection against Major Accidents (Major Accidents Ordinance, MAO) of 27 February 1991 (Status as of 1 April 2013) The Swiss Federal Council, on the basis of Article 10 paragraph 4 and Article 39 paragraph 1 of the Federal Act of 7 October 19831 on the Protection of the Environment (EPA) and Article 47 paragraph 1 of the Waters Protection Act of 24 January 19912,3 ordains: Section 1: General Provisions Art. 1 Purpose and scope Art. 2 Definitions Section 2: Principles of Prevention Art. 3 General safety measures Art. 4 Special safety measures for establishments Art. 5 Summary report Art. 6 Evaluation of the summary report, risk report Art. 7 Evaluation of the risk report Art. 8 Additional safety measures Art. 9 Disclosure of results of regulatory review Art. 10 Information on the transport of dangerous goods Section 3: Response to Major Accidents Art. 11

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				Section 4: Responsibilities of the Cantons Art. 11a Coordination with structure and land use plans Art. 12 Point of contact Art. 13 Information and alerts Art. 14 Coordination of emergency services Art. 15 Coordination of inspections of establishments Art. 16 Provision of information to the Federal Office Section 5: Responsibilities of the Confederation Art. 17 Data collection by the Federal Office Art. 18 Data concerning the import, export and transit of dangerous goods by road Art. 19 Processing of data concerning the transport of dangerous goods by road Art. 20 Information Art. 21 Expert commissions Art. 22 Guidelines Section 6: Final Provisions Art. 23 Enforcement Art. 24 Amendment of existing legislation Art. 25 Transitional provisions Art. 25a Transitional provisions relating to the amendment of 13 February 2013 Art. 26 Commencement Annex 1 - Scope and summary report - Threshold quantities for substances, preparations or special wastes - 1 ... - 2 Determination of threshold quantities - 21 Substances or preparations - 22 Special wastes - 3 Substances and preparations with specified threshold quantities (list of exceptions) - Substance name - 4 Criteria for determining threshold quantities - 41 Toxicity - 42 Fire and explosion characteristics

#	Subject	Law	Website	Content (English)
				- 43 Ecotoxicity - 5 … (...) Annex 1.3 - Criteria for pipeline installations Annex 2 - Principles for the adoption of general safety measures - Establishments handling substances, preparations or special wastes (...) Annex 2.3 - Transport routes (...) Annex 3 - Special safety measures - Establishments handling substances, preparations or special wastes (...) Annex 4 - Risk report - Establishments handling substances, preparations or special wastes - 1 Principles - 2 Basic data - 21 Establishment and surrounding area - 22 List of substances, preparations or special wastes present in each study unit - 23 Description of installations in each study unit - 24 Safety measures in each study unit - 3 Analysis for each study unit - 31 Methods - 32 Hazard potentials - 33 Main major accident scenarios - 331 Release process - 332 Effects of release

#	Subject	Law	Website	Content (English)
				- 333 Consequences for the public and the environment - 4 Conclusions - 5 Summary of the risk report (...) Annex 4.3 - Transport routes - 1 Principles - 2 Basic data - 21 Transport route and surrounding area - 22 Volume and structure of traffic and accident statistics - 23 Safety measures - 3 Analysis - 31 Methods - 32 Hazard potentials - 33 Main major accident scenarios - 4 Conclusions - 5 Summary of the risk report (...) AS 1991 748 1 SR 814.01 2 SR 814.20 3 Amended by No I of the Ordinance of 13 Feb. 2013, in force since 1 April 2013 (AS 2013 749).
5	Accidents and Occupational Diseases	SR 832.30 Ordinance of 19 December 1983 (status as of May 15, 2012) on the prevention of accidents and	http://www.admin.ch/opc/de/classified-compilation/19830377/index.html	**Table of Content for linked document. Please use link to access full text.** 832.30 Ordinance on the prevention of accidents and occupational diseases (Regulation on the prevention of accidents, VUV) of 19 December 1983 (as of May 15, 2012). The Swiss Federal Council, having regard to Rule 81 of the Federal Act of 6 October 20001 on the General Part of Social Insurance Law (ATSG) , Articles 79, paragraph 1, 81-88 and 96 letters c and f of the Federal Act of 20 March 19812 on Accident Insurance (Law / LAA) and Article 40 of the Labor Code of 13 March 19643 (ArG), prescribed:

#	Subject	Law	Website	Content (English)
		occupational diseases (VUV)		1st Title : Provisions governing the prevention of occupational accidents and occupational diseases (occupational safety) 1st Chapter : Scope 2nd Chapter : Duties of employers and of workers in general 1st Section : Obligations of the employer 2nd Section : Duties of the employee 3rd Section: Involvement of occupational physicians and other occupational safety specialists 3rd Chapter : Safety requirements 2nd Title : Organization 1st Chapter : Safety 1st Section : Implementing Institutions 2nd Section : Coordination Commission 2nd Chapter : Prevention of non-occupational accidents 3rd Title : Enforcement of regulations on work safety 1st Chapter : Control, arrangements and enforcement 2nd Chapter : Exemptions 3rd Chapter : Database of Coordination Commission 4th Title: Occupational health care 1st Chapter : insinuation 2nd Chapter : checkups 3rd Chapter : exclusion of vulnerable workers 4th Chapter : claims of worker 5th Title : Financing 1st Chapter : Safety 2nd Chapter : Prevention of non-occupational accidents 6th Title : ... 7th Title: Final provisions
6	Alcohol and Drug Use	Guideline (SUVA) for employers and	**Error! Hyperlink reference**	**Overview of subject matter. Please use links to access full text of relevant legal documents.** Source: Alcohol in the workplace. Information for employers and

#	Subject	Law	Website	Content (English)
		employees on Alcohol at the workplace	**not valid.**	employees. When is alcohol a problem in the workplace? A responsible approach to alcohol is accepted in our society. Most people drink alcohol in amounts that do not jeopardize their health. However, an estimated 4 percent of Swiss residents over 15 year's age depend on alcohol. The percentage of alcohol dependents is expected to be similar amongst the working population. For employees driving vehicles, or operate dangerous machinery, the consumption of alcohol is always problematic. The consumption of alcohol, even in small amounts, affect attention, concentration and responsiveness. Vision and hearing diminish and the criticism and judgment declines. At the same time the risk increases. **Occupational safety** Do not hesitate to report to a supervisor if you suspect that employees are not able to take responsibility e.g. for the operation of dangerous machines. Do this regardless of whether the cause is alcohol consumption, fatigue, disease or something else the cause. It is about preventing people from endangering themselves or others. **Alcohol prevention program** The introduction of an alcohol prevention program in more and more companies is part of the company policy. An alcohol prevention program aims to help persons with problematic alcohol use or a dependence disorder. Small companies rarely have a comprehensive alcohol prevention program. But even there it is useful to have rules for the consumption of alcohol in the workplace. Who is responsible? **Basically everyone is responsible for their own behavior.**

#	Subject	Law	Website	Content (English)
				Employees must follow the instructions of the employer in line with general occupational health safety rules (article 11, paragraph 1 VUV) . With respect to the alcohol, this means that employees must not drink alcohol before and during work if doing so puts themselves or others at risk. The employer is legally responsible. He is obliged by law to take all appropriate measures to prevent accidents (Swiss Civil Cod of Obligations, "Obligationenrecht", Art. 328 OR). This includes also supervisors stopping employees from doing work, if the presumption is that they are not capable of carrying out their work without putting themselves or others at risk. **Employees bear no legal responsibility. However, if** a colleague causes an accident, this can be very stressful. Especially if the employees knew that the person responsible for the accident was under the influence of alcohol.
7	Alcohol and Drug Use	Swiss Code of Obligations (OR) Division Two: Types of Contractual Relationship Title Ten: The Employment Contract Section One: The Individual Employment Contract	http://www.admin.ch/ch/e/rs/220/a328.html	**Translation of relevant content. Use link to access full document.** Extract from the Federal Act on the Amendment of the Swiss Civil Code (Part 5, The Code of Obligations, "Obligationenrecht (OR)", of 30 March 1911, status as of 1 January 2013, with relevance for alcohol in the workplace: Code of Obligations Division Two: Types of Contractual Relationship Title Ten: The Employment Contract Section One: The Individual Employment Contract Art. 328: VII. Protection of the employee's personality rights 1. In general Within the employment relationship, the employer must acknowledge and safeguard the employee's personality rights, have due regard for his health and ensure that proper moral standards are maintained. In particular, he must ensure that employees are not sexually harassed and that any victim of sexual harassment suffers no further adverse consequences.

#	Subject	Law	Website	Content (English)
		Art. 328: Protection of the employee's personality rights		In order to safeguard the personal safety, health and integrity of his employees he must take all measures that are shown by experience to be necessary, that are feasible using the latest technology and that are appropriate to the particular circumstances of the workplace or the household, provided such measures may equitably be expected of him in the light of each specific employment relationship and the nature of the work.
8	Construction Site Safety	Planning tool (SUVA) on the Site Specific measures for health and safety	https://extra.suva.ch/suva/b2c/productQuickLink.do?shop=B2C_WW_de&language=de&productnr=88218.D	**Translation of relevant content. Use link to access full document.** Planning tool. "Site Specific measures for health and safety" Site -specific safety and health protection measures (see box) must be planned and during the execution of the construction work will be coordinated . The coordination of these measures is governed by Article 9 of the “Regulation on the prevention of accidents and occupational diseases " VUV . According to VUV, employers involved in a building denying the necessary measures against each other. Article 3 of Regulation Bauarbeitenverord concretized this coordination requirement. This planning tool is to assist the parties involved to identify those site- specific measures that are required for the safe execution of their work. The tool is aimed primarily at employers. However, it may also be useful to the site management: as a planning aid for the procurement of construction sites - specific measures and for monitoring the implementation. Site -specific measures According to construction regulation (Article 3, paragraph 3) are considered site-specific measures those protective devices , which are used by several entrepreneurs : for example, scaffolding, safety nets , walkways , security measures in trenches and excavation or cavity assurance measures in underground construction . Obligations of the employer (contractor) • The employer must be prior to the completion of the works

#	Subject	Law	Website	Content (English)
				contract the necessary protective measures at the work to be performed safely . • He has to arrange that the site- specific occupational safety and health protection measures to be included in the work contract and specified in the same way as the other contents of the contract (see attached list " standard item catalog " Order 88218/1.d) . Those protective measures that are already regulated by another contractor, must be merely mentioned in the contract. • Transmits the employer the work of a third-party company, so he has to ensure that they realized the protective measures that are included in the work contract. Inclusion of the construction management • A commitment by the construction management for the planning and coordination of site- specific measures is not intended to regulation level. The construction management but is included with - in ensuring the safety. According to SIA standard 118, Article 34.3, it ensures the timely coordination of the work of all contractors involved in the building. They have to take the necessary protective measures for accident prevention and health care, they will be supported by the construction supervision, as the representative of the client, support (SIA standard 118, Article 104). • In addition, the site management can after an accident - are supported drawn to Article 229 of the Criminal Code accountable if the recognized rules of construction customer have been left out of consideration in the management or execution of the works.
9	Construction Site Safety	Guideline (SUVA) on dealing with Electricity on Construction Sites	https://extra.suva.ch/suva/b2c/productQuickLink.do?shop=B2C_WW_de&language=de&productnr=67081%2eD	**Translation of relevant content. Use link to access full document.** Checklist electricity on construction sites 1 Basic knowledge for the practitioner 2 Do you know the dangers? Who wants to trade confidently must know where the dangers lie. What are the most common hazard situations? Three ways to hurt yourself Under what circumstances it comes to serious injury?

#	Subject	Law	Website	Content (English)
				How does it fire? 3 safety technology saves lives But only if we apply them correctly A Brief Introduction to Electrical Engineering GFCI: simple and ingenious What afford overcurrent breaker (eg, fuses)? Protection classes for electrical appliances 4 Safety Tips The most important thing for the daily work 5 Maintenance and inspections Maintenance of machinery and equipment Inspection of electrical installations How is a "visual inspection" conducted? 6 Who can create electrical installations?
10	Crane Inspections and Maintenance	Federal Office for Health and Safety in the Workplace (EKAS) Directive 6511 on the Verification and control of mobile cranes and tower cranes	http://www.ekas.admin.ch/index-de.php?frameset=200	**Full Table of Content plus translation of sele3ct passages for linked document. Please use link to access full text.** EKAS Directive 6511 on the Verification and control of mobile cranes and tower cranes Content 1 Introduction 1.1 Purpose 1.2 Scope of application 1.3 Legal Basis 1.4 Terms 2 Tasks and responsibilities 2.1 Duties of crane operator 2.2 Role of the crane experts 2.3 Tasks of the Suva

#	Subject	Law	Website	Content (English)
				3 verification and control of cranes 3.1 Daily inspection by the crane operator 3.2 Annual review by the crane expert 3.3 Checking after installation, modification or particular events 3.4 Periodic inspection by the crane experts Annex: Crane pictures **Translation of select content :** 1 Introduction 1.1 Legal Basis Federal Law on Accident Insurance (UVG) The UVG provides in Article 82 paragraph 1 to the fundamental requirement that the employer must take all measures for the prevention of occupational accidents and occupational diseases , which are applicable after the experience necessary, according to the prior art, and appropriate to the prevailing conditions . Regulation on the prevention of accidents and occupational diseases (VUV) The VUV contains , implementing provisions mentioned fundamental requirement of the LAA. Regulation on the safe use of cranes (Crane Regulation) This special regulation governs the safe use of cranes. In the specification of the mentioned regulations also following laws and regulations have been taken into account: Data Protection Act (DPA) The DPA in Article 12 refers to "personal injuries" and how to deal with related personal data. This concerns in particular data on the health of the crane operator. Federal Law on the work in industry, commerce and trade (ArG) 5 Working with lifting cranes is considered dangerous . Therefore enjoy young people, drawing on the ArG Article 29, paragraph 3, a

#	Subject	Law	Website	Content (English)
				special protection. 1.2 Purpose The Directive provides for the uniform , proper, and in the art appropriate application of the rules relating to the safe use of vehicle cranes and tower cranes and shows employers a way on how they can meet their obligations. The policy highlights, in particular, how the card for crane leaders and crane operator can be acquired and how the basic training required for this is to make for the safe operation of vehicle and tower cranes. For this purpose it is stated what conditions must meet basic courses and examination in order to be recognized by the Suva. With the acquired ID card crane leaders and crane operator in Switzerland can be active. 1.3 Terminology With names such candidate, candidate, a trainer, trainers, Prüfungsexper - tin , an examiner , a crane operator , crane operator , the masculine form is used in the rule. 1.3.1 School, sponsorship « Schools » Basic courses or tests covered by this Directive. It may be natural or legal persons. A “sponsorship" is an association (a syndicate) of various partners who want to perform basic courses and exams. This must be a legal person is not necessarily. However, the sponsorship has a " Training center” to appoint, by which it is represented to the outside. 1.3.2 Candidates " Candidates” are persons who attend a basic course or have a valid ticket or learning to take the exam.

#	Subject	Law	Website	Content (English)
				1.3.3 Trainers «Trainers" are persons who teach on behalf of schools in basic courses candidates. 1.3.4 Examiners "Examiners" are persons who, on behalf of educational institutions, conduct tests and assess Crane Operator Candidates. 1.3.5 Cranes, mobile cranes, tower cranes Mobile cranes in practice comprise all cranes that are constructed comparably and are used for similar work, especially for assembly work. They also show similar accident risk profiles. Specifically, truck cranes, mobile cranes are considered only on the basis of an additionally mounted boom extension. Includes boom extension mounted a boom length of over 22 m are possible , they are regarded as mobile cranes , irrespective of on which type vehicle they are constructed . Is the boom extension dismantled and cannot be exceeded as the boom length of 22 m , trucks Cranes apply in relation to the identification requirement is not as mobile cranes . Tower cranes according to point b in practice comprise all cranes that are constructed comparable, function and comparable for similar work, especially on construction sites, are used in a stationary variable and temporary. They also have a similar risk of accidents. Specifically, tower cranes, which are on a trailer or a truck chassis built up. People that make up such a crane, need a card category A “mobile cranes”. To operate is an identity category A or B " tower cranes » required. Images of Mobile cranes (Category A) and tower cranes (Category B) are found in Appendix 1 of this Directive. Other cranes, according to letter c of this Directive are not within the scope.

#	Subject	Law	Website	Content (English)
11	Dangerous Substances / Chemicals (Epoxy Paint used on WTG & offshore foundations, gear oil etc.)	SR 813.1 Federal Act of 15 December 2000 (Status as of 13 June 2006) on Protection against Dangerous Substances and Preparations (Chemicals Act, ChemA)	http://www.admin.ch/opc/en/classified-compilation/19995887/index.html	**Table of Content for linked document. Please use link to access full text.** Federal Act on Protection against Dangerous Substances and Preparations (Chemicals Act, ChemA) of 15 December 2000 (Status as of 13 June 2006) The Federal Assembly of the Swiss Confederation, based on Articles 95 paragraph 1, 110 paragraph 1 letter a and 118 paragraph 2 letter a of the Federal Constitution, and having considered the Dispatch of the Federal Council dated 24 November 1999, ordains: Chapter 1: General Provisions and Principles Section 1: General Provisions Section 2: Principles for the Handling of Substances and Preparations Chapter 2: Notification of and Authorization for Specific Substances and Preparations Chapter 3: Special Provisions concerning the Handling of Substances and Preparations Chapter 4: Documentation and Information Chapter 5: Enforcement Section 1: Cantons Section 2: Federal Government Section 3: Special Regulations on Enforcement Chapter 6: ... Chapter 7: Criminal Provisions Chapter 8: Final Provisions Annex
12	Dangerous Substances / Chemicals (Epoxy Paint used on WTG & offshore foundations, gear oil	SR 813.11 Ordinance of 18 May 2005 on Protection against Dangerous Substances and	http://www.admin.ch/ch/e/rs/813_11/index.html	**Full Table of Content for linked document. Please use link to access full text.** Ordinance on Protection against Dangerous Substances and Preparations (Chemicals Ordinance, ChemO) of 18 May 2005 (Status as of 15 January 2013) This translation does not yet include the amendments of 1.6.2015 (AS 2012 6103)

#	Subject	Law	Website	Content (English)
	etc.)	Preparations (Chemicals Ordinance, ChemO)		The Swiss Federal Council, based on the Chemicals Act of 15 December 2000 (ChemA)1, on Article 26 paragraph 3, Article 29, Articles 30a–30d, Article 38 paragraph 3, Article 39 paragraph 1, Article 41 paragraph 3, Article 44 paragraphs 2 and 3, Article 46 paragraphs 2 and 3, and Article 48 paragraph 2 of the Federal Act of 7 October 1983 on the Protection of the Environment (EPA)2, and on Article 9 paragraph 2 letter c, Article 27 paragraph 2 and Article 48 paragraph 2 of the Waters Protection Act of 24 January 19913, and in implementation of the Federal Act of 6 October 19954 on Technical Barriers to Trade,5 ordains: Title 1: General Provisions Art. 1 Aim and scope Art. 2 Definitions Art. 3 Dangerous substances and preparations Art. 4 Hazardous physicochemical properties Art. 5 Properties dangerous to health Art. 6 Properties dangerous to the environment Art. 6a Persistence, bioaccumulation and toxicity Title 2: Marketing Requirements Chapter 1: Self-Regulation Section 1: Fundamental Obligations Art. 7 General provisions Art. 7a Section 2: Classification of Substances Art. 8 Classification by the manufacturer Art. 9 Official classification Section 3: Classification of Preparations Art. 10 Principle Art. 11 Classification with regard to hazardous physical and chemical properties Art. 12 Classification with regard to properties dangerous to health Art. 13 Classification with regard to properties dangerous to the

#	Subject	Law	Website	Content (English)
				environment Art. 14 Concentrations requiring substances to be taken into consideration Art. 15 Re-evaluation with regard to properties dangerous to health or the environment Chapter 2: Notification of New Substances and Declaration of New Substances not subject to Notification Requirements Section 1: Notification of New Substances Art. 16 Obligation to notify Art. 16a Relevant quantity of a substance Art. 17 Exemptions from the obligation to notify Art. 18 Form and content of the notification Art. 18a Chemical safety reports Art. 18b Substances for which a notification has been submitted in the EU prior to 1 June 2008 Art. 19 Section 2: Use of Data from Previous Notifiers and Data Protection Period Art. 20 Use of data from previous notifiers Art. 21 Data protection period Art. 22 Mandatory advance enquiries to avoid tests on vertebrates Art. 23 Use of data from previous tests with vertebrates Art. 24 Previous notifiers' entitlement to remuneration for data from tests on vertebrates Section 3: Declaration of New Substances for Product and Process-orientated Research and Development6 Art. 25 Obligation to make a declaration Art. 26 Form and content of the declaration Section 4: Procedure for Notification and Declaration Art. 27 Confirmation of receipt and forwarding of the documents Art. 28 Review of the notification or declaration Art. 29 Additions to the documents Art. 30 Acceptance of the notification or declaration Section 5: Authorization to Place Substances on the Market

#	Subject	Law	Website	Content (English)
				Art. 31 Placing substances subject to notification requirements on the market Art. 32 Placing substances subject to declaration requirements on the market Chapter 3: Requirements for Tests Art. 33 Principle Art. 34 Requirements Chapter 4: Packaging and Labelling7 Section 1:8 Packaging and Labelling of Dangerous Substances Art. 34a Packaging Art. 34b Labelling Art. 34c Exemptions from labelling requirements Art. 34d Labelling of dangerous substances for export Section 2: Packaging and Labelling of Preparations9 Art. 34e General provisions Art. 35 Characteristics of packaging Art. 36 Design of packaging Art. 37 Special provisions Art. 38 Exemptions Art. 39 Labelling of dangerous preparations Art. 40 Labelling of preparations posing particular hazards Art. 41 and 42 Art. 43 Use of an alternative chemical name Art. 44 Requests to use an alternative chemical name Art. 45 Prohibition on misleading labelling Art. 46 Optional labelling Art. 47 Implementation of labelling Art. 48 Inner and outer packages Art. 48a Derogations from the labelling requirements Art. 49 Art. 50 Exemptions Chapter 4a: Exposure Scenarios and Safety Data Sheet10 Section 1:11 Exposure Scenarios Art. 50a

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				Section 2: Safety Data Sheet12 Art. 51 Purpose Art. 52 Obligation to compile a safety data sheet Art. 53 Requirements for safety data sheets and their compilation Art. 54 Obligation to provide safety data sheets Art. 55 Updating Art. 56 Obligation to retain safety data sheets Art. 56a Art. 56b–56e Title 3: Obligations after Placing on the Market Chapter 1: Taking Account of new Information Relevant to Assessment, Classification and Labelling Art. 57 Reassessment of substances, preparations and objects Art. 58 Updating and retention of documents Chapter 2: Updated Information and Additional Test Reports on new Substances Art. 59 Updated information Art. 60 Information to be submitted based on quantities Chapter 3: Obligation to Register Art. 61 Substances and preparations subject to registration requirements Art. 62 and 63 Art. 64 Content of the registration application Art. 65 Extended registration application Art. 66 Form of the registration application and the extended registration application Art. 67 Modifications Art. 68 Special form of compliance with the obligation to register Art. 69 Exemptions from the obligation to register Title 4: Handling of Substances, Preparations and Objects Chapter 1: General Provisions Art. 70 Taking account of the information provided by the manufacturer

#	Subject	Law	Website	Content (English)
				Art. 71 Environmental release Art. 72 Storage Art. 73 Specific obligations when supplying substances and preparations Art. 74 Chemicals contact person Art. 75 Advertising Chapter 2: Handling of Dangerous Substances and Preparations in Groups 1 and 213 Art. 76 Dangerous substances and preparations in Groups 1 and 2 Art. 77 Storage Art. 78 Exclusion of self-service Art. 79 Supply restrictions Art. 80 Special obligations with regard to supply Art. 81 Knowledge required to supply Art. 82 Theft, loss, erroneous placing on the market Art. 83 Samples Art. 83a Substances and preparations intended for self-defense Chapter 3:14 Handling of Substances of Very High Concern Art. 83b List of substances of very high concern Art. 83c Objects containing substances of very high concern Title 5: Data Processing Art. 84 Register of products Art. 85 Confidential data Art. 86 Data to be passed on to the Notification Authority and the assessment authorities Art. 87 Exchange of information and data Art. 88 Passing-on of data to other countries and to international organizations Title 6: Enforcement Chapter 1: Confederation Section 1: Organization Art. 89 Notification Authority and steering committee Art. 90 Assessment authorities Art. 91 Poisons information center

#	Subject	Law	Website	Content (English)
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				January 2009 Art. 110c Transitional provisions concerning the Amendment of 10 November 2010 Art. 110d Transitional provisions concerning the Amendment of 7 November 2012 Chapter 2: Commencement Art. 111 Annex 1 - Labelling of preparations - 1 Dangers - 1.1 Danger symbols and indications of danger - 1.2 Assignment of danger symbols and indications of danger - 2 Special Risks - 2.1 R-phrases - 2.2 Combined R-phrases - 2.3 Assignment of R-phrases - 2.4 Choice of R-phrases - 2.5 Exemptions - 3 Safety Advice - 3.1 S-phrases - 3.2 Combined S-phrases - 3.3 Assignment of S-phrases - 3.4 Exemptions - 4 Declaration of Dangerous Substances in Preparations - 5 Provisions relating to Preparations with Special Risks - 5.1 Cyanoacrylate-based adhesives - 5.2 Preparations containing isocyanates - 5.3 Preparations containing epoxy constituents with an average molecular weight £ 700 - 5.4 Preparations which contain active chlorine - 5.5 Preparations containing cadmium (alloys) and intended to be used for brazing or soldering - 5.6 Preparations available as aerosols - 5.7 Preparations not classified as sensitizing but containing at least one substance classified as s... - 5.8 Liquid preparations containing halogenated hydrocarbons - 5.9 Preparations not classified as dangerous but containing at least one dangerous substance and not... - 5.10 Preparations containing a substance assigned R-phrase R 67

#	Subject	Law	Website	Content (English)
				- 5.11 Dangerous preparations available to the general public - 5.12 Dangerous preparations intended for use by spraying - 5.13 Preparations containing a substance assigned R-phrase R 33 - 5.14 Preparations containing a substance assigned R-phrase R 64 - 6 Label - 7 Optional Labelling - 7.1 Indications of dangers for the environment - 7.2 Information on protective measures Annex 2 Annex 3 - Technical Dossier - General Provisions - 1 General Notifier Information - 2 Identification of the Substance - 3 Information on Manufacture and Use - 4 Classification and Labelling - 5 Guidance on Safe Use - 6 Information on Exposure (1–10 tons per year) - 7 Information on Physicochemical Properties - 8 Toxicological Information - 9 Exotoxicological Information - 10 Omission of certain Tests Annex 4 Annex 5 - Correspondences between expressions, legislation and individual provisions - 1 Equivalent expressions - 2 Swiss provisions corresponding to EU legislation cited in the REACH Regulation and in the CLP Regu... Annex 6 - Substances and preparations in Groups 1 and 2 - 1 Substances and preparations labelled in accordance with the CLP Regulation - 1.1 Group 1 - 1.2 Group 2

#	Subject	Law	Website	Content (English)
				- 2 Substances and preparations not yet labelled in accordance with the CLP Regulation - 2.1 Group 1 - 2.2 Group 2 Annex 7 - List of substances of very high concern (candidate list)
13	Dangerous Substances / Chemicals (Epoxy Paint used on WTG & offshore foundations, gear oil etc.)	SR 814.81 Ordinance of 18 May 2005 on the Reduction of Risks relating to the Use of Certain Particularly Dangerous Substances, Preparations and Articles (Chemical Risk Reduction Ordinance, ORRChem)	http://www.admin.ch/ch/e/rs/814_81/a18.html	**Full Table of Content for linked document. Please use link to access full text.** Ordinance on the Reduction of Risks relating to the Use of Certain Particularly Dangerous Substances, Preparations and Articles (Chemical Risk Reduction Ordinance, ORRChem) of 18 May 2005 (Status as of 1 December 2013) The Swiss Federal Council, on the basis of Article 2 paragraph 4, Article 19, Article 22 paragraph 2, Article 24, Article 38, Article 39 paragraph 2, Article 44 paragraph 2, Article 45 paragraphs 2 and 5 and Article 46 paragraph 1 of the Chemicals Act of 15 December 20001 (ChemA), on the basis of Article 27 paragraph 2, Article 29, Article 30a, Article 30b, Article 30c paragraph 3, Article 30d, Article 32abis, Article 38 paragraph 3, Article 39 paragraphs 1 and 1bis, Article 41 paragraph 3, Article 44 paragraphs 2 and 3, Article 46 paragraphs 2 and 3, Article 48 paragraph 2 and Article 63 paragraph 2 of the Environmental Protection Act of 7 October 19832 (EPA), on the basis of Article 9 paragraph 2 letter c, Article 27 paragraph 2 and Article 48 paragraph 2 of the Waters Protection Act of 24 January 19913, on the basis of Article 9 and Article 14 paragraph 2 of the Foodstuffs Act of 9 October 19924, and in implementation of the Federal Act of 6 October 19955 on Technical Barriers to Trade,6 ordains: Chapter 1: General Provisions

#	Subject	Law	Website	Content (English)
				Art. 1 Purpose and scope Art. 2 Definitions Chapter 2: Use of Substances, Preparations and Articles Section 1: Restrictions, Prohibitions and Exemptions Art. 3 Section 2: Authorizations Art. 4 Applications requiring authorization Art. 5 Requirements for authorization Art. 6 Coordination Section 3: Certificates Art. 7 Use of substances and preparations requiring a certificate Art. 8 Proof of specialist knowledge Art. 9 Geographical applicability Art. 10 Continuing education and training requirements Art. 11 Sanctions Art. 12 Responsibilities Chapter 3: Enforcement Art. 13 Cantons Art. 14 Confederation Art. 15 Delegation of tasks and powers to third parties Art. 16 Special provisions concerning enforcement Art. 17 Monitoring of imports and exports Art. 18 Inspections 1 On a spot-check basis or at the request of the FOPH, FOAG or FOEN, the cantonal enforcement authorities shall inspect substances, preparations and articles placed on the market at the premises of manufacturers, traders and professional or commercial users. They shall check whether the substances, preparations and articles comply with the provisions of the Annexes, in particular with regard to composition, labelling and information for purchasers. 2 They shall also check whether the use of these substances, preparations and articles complies with the requirements of this

#	Subject	Law	Website	Content (English)
				Ordinance. 3 If the substances, preparations or articles inspected or the use thereof give cause for complaint, the inspection authority shall inform the authorities responsible for rulings under Article 19. If the latter are cantonal authorities, it shall additionally inform the FOPH and FOEN and also, in cases of complaints concerning plant protection products, the FSVO and the FOAG, or in cases of complaints concerning fertilizers, the FOAG.1 -- Art. 19 Rulings arising from inspections If an inspection reveals that provisions of this Ordinance have been violated, the federal authority or the authority of the canton in which the manufacturer, trader or user is domiciled or has a registered office shall, by means of a ruling, order the necessary measures. Art. 20 Specialist advice on the use of fertilizers and plant protection products Art. 21 Data confidentiality and data exchange Art. 22 Fees
14	Dangerous Substances / Chemicals (Epoxy Paint used on WTG & offshore foundations, gear oil etc.)	Swiss Regulation (SR) on dangerous or hazardous substances and chemicals	http://www.admin.ch/opc/en/classified-compilation/8.html	**Edited list of Swiss Regulation (SR) on chemicals with relevance to the owner / operator of wind turbine generators (WTGs).** SR 813 Chemicals SR 813.1 Federal Act of 15 December 2000 on protection against dangerous substances and preparations (Chemicals Act, ChemG) SR 813.11 Ordinance of 18 May 2005 concerning the protection against dangerous substances and preparations (Substances Lists, ChemO) SR 813.112.1 Ordinance of 18 May 2005 Good Laboratory Practice (OGLP) SR 813.112.12 Ordinance of the EDI of 28 June 2005 on the classification and labeling of substances

#	Subject	Law	Website	Content (English)
				SR 813.113.11 Ordinance of the EDI of 28 June 2005 on the chemicals contact person SR 813.131.21 Ordinance of the EDI of 28 June 2005 on the necessary expertise for the delivery of certain dangerous substances and preparations SR 813 132 Chemicals in International Trade see → SR 814.82 SR 813 814 Chemical Risk Reduction see → SR 814.81
15	Environmental Safety: Waste Categories	SR 814.610.1 DETEC Ordinance on Lists relating to Movements of Waste (LMW)	http://www.admin.ch/opc/de/classified-compilation/20021081/index.html	**Table of Content for linked document. Please use link to access full text.** DETEC Ordinance on lists for movement of waste from 18 October 2005 (as of 1 January 2010). --- EXTRACT WTG relevant legislation: See detailed list of waste falling under category 13 (machine oils) below, and under category 18 (waste from construction activities), refer to linked source. Chapter 13 Oil wastes and wastes of liquid fuels (except edible oils and waste oils falling under Chapters 05, 12 or 19) 13 01 waste hydraulic oils 13 01 01 S Hydraulic oils containing PCBs 13 01 04 S Chlorinated emulsions 13 01 05 S Non-chlorinated emulsions 13 01 09 S Chlorinated hydraulic oils based on mineral oil 13 01 10 S Non-chlorinated hydraulic oils based on mineral oil 13 01 11 S Synthetic Hydraulic Oils 13 01 12 S readily biodegradable hydraulic oils 13 01 13 S other hydraulic oils 13 02 waste engine , gear and lubricating oils 13 02 04 S Chlorinated engine, gear and lubricating oils based on mineral oil 13 02 05 S non-chlorinated engine , gear and lubricating oils based

#	Subject	Law	Website	Content (English)
				on mineral oil 13 02 06 S Synthetic engine, gear and lubricating oils 13 02 07 S readily biodegradable engine, gear and lubricating oils 13 02 08 S other engine, gear and lubricating oils (including mineral oil mixtures) 13 03 waste insulating and heat transmission oils 13 03 01 S insulating and heat transmission oils containing PCBs 13 03 06 S Chlorinated insulating and heat transmission oils based on mineral oils other than those mentioned in 13 03 01 13 03 07 S non-chlorinated insulating and heat transmission oils other mineral - oil-based 13 03 08 S Synthetic insulating and heat transmission oils 13 03 09 S readily biodegradable insulating and heat transmission oils 13 03 10 S other insulating and heat transmission oils 13 04 bilge oils 13 04 01 S bilge oils from inland navigation 13 04 02 S bilge oils from jetty sewers 13 04 03 S bilge oils from other navigation 13 05 content of Öl-/Wasserabscheidern 13 05 01 S Solid wastes from grit chambers and Öl-/Wasserabscheidern 13 05 02 sludges from S Öl-/Wasserabscheidern 13 05 06 S oils from Öl-/Wasserabscheidern 13 05 07 S Oily water from Öl-/Wasserabscheidern 13 05 08 S mixtures of wastes from grit chambers and Öl-/Wasserabscheidern 13 07 wastes of liquid fuels 13 07 01 S fuel oil and diesel 13 07 02 S Petrol 13 07 03 S other fuels (including mixtures) Not mentioned 13 08 oil waste elsewhere 13 08 01 S sludges or emulsions of desalters 13 08 02 S Other emulsions Not mentioned 13 08 99 Wastes not otherwise S

#	Subject	Law	Website	Content (English)
				-- TOC The Federal Department of Environment, Transport, Energy and Communications (UVEK), having regard to Articles 2, 12, paragraph 2 and 15 paragraph 3 of the Decree of 22 June 20051 on the marketing of waste (OMW) and Appendix 1.1 Paragraph 22 of the Hazardous Incident Ordinance of 27 February 19912 (OMA) prescribed: Single Article 1 This Regulation lays down: a. in Annex 1 the list of wastes pursuant to Article 2 OMW; b. in Annex 2 to the list of methods of disposal referred to in Articles 12, paragraph 2 and 15 paragraph 3 OMW; c. in Annex 3, the threshold quantities for hazardous waste according to Annex 1.1, paragraph 22 StFV. 2 The Regulation shall take effect on 1 January 2006. Annex 11 Annex 2 Appendix 31 AS 2005 5149 1 SR 814.610 2 SR 814.012 Annex 11 - List of Wastes 1 General Information 1.1 Classification of waste 1 In the list of wastes are particularly referred to : a hazardous waste : S ; b . other wastes subject to control : with ak 2 wastes that qualify as inert substances referred to in Annex 1, paragraph 11 of the Technical Regulation of 10 Meet in December 19902 on waste , no hazardous waste . 3 The Federal Office for the Environment (FOEN) adopt an implementation guide for the attention of law enforcement

#	Subject	Law	Website	Content (English)
				agencies to assess the question of whether a waste is hazardous waste or not. It takes into account , in particular, Article 2 OMW and Annex III of the Basel Convention of 22 March 19893 on the control of transboundary movements of hazardous wastes and their disposal . 1.2 coding 1 The code of a drop of six digits . 2 In determining the code of a drop , proceed in the following steps: 1 According to the origin of the waste is to be found in Chapters 01-12 and 17-20 of the applicable code. Coding with the final digit 99 " waste not mentioned elsewhere " is not allowed in this step. 2 Can be found in chapters 01-12 and 17-20 no true code, the chapter must be 13-15 used for coding. 3 Can be found in chapters 13-15 no true code , then the chapter 16 must be used for encoding. 4 Can be found in chapter 16 no true code , then from chapters 01-12 and 17-20 the one chapter select which corresponds to the origin of the waste at best, and from this the code with the final digit 99 " Wastes not otherwise specified " to use . 2 Overview of the chapters of the Waste List 01 Waste resulting from exploration, mining , quarrying, physical and chemical treatment of minerals 02 Wastes from agriculture, horticulture, aquaculture, forestry , hunting and fishing as well as the production and processing of foodstuffs 03 Wastes from wood processing and the production of panels and furniture, pulp , paper and cardboard 04 Wastes from the leather, fur and textile industries 05 Wastes from petroleum refining, natural gas purification and pyrolytic treatment of coal

#	Subject	Law	Website	Content (English)
				06 Wastes from inorganic chemical processes 07 Wastes from organic chemical processes 08 Wastes from the manufacture, formulation , supply and use of coatings (paints, varnishes, enamels), adhesives , sealants and printing inks 09 Wastes from the photographic industry 10 Wastes from thermal processes 11 Wastes from chemical surface treatment and coating of metals and other materials , non -ferrous hydrometallurgical processes 12 Wastes from the mechanical shaping and physical and mechanical surface treatment of metals and plastics 13 Oil wastes and wastes of liquid fuels (except edible oils and waste oils falling under Chapters 05, 12 or 19) 14 Waste organic solvents , refrigerants and propellants (except those falling under Chapter 07 or 08) 15 Packaging waste , absorbents, wiping cloths, filter materials and protective clothing (not otherwise specified) 16 Wastes not otherwise specified in the list 17 Construction waste and excavated soil 18 Wastes from human or animal health care and research
16	Environmental Safety: Waste Transport	Basel Convention on the Control of Transboundary	http://www.basel.int/Portals/4/Basel%20Convention/docs/text/BaselConv	**Overview of content. Please use link to access full text.** The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted on 22 March 1989 by the Conference of Plenipotentiaries in Basel, Switzerland, in response to a public outcry following the discovery, in the 1980s,

#	Subject	Law	Website	Content (English)
		Movements of Hazardous Wastes and their Disposal adopted on 22 March 1989	entionText-e.pdf	in Africa and other parts of the developing world of deposits of toxic wastes imported from abroad. Awakening environmental awareness and corresponding tightening of environmental regulations in the industrialized world in the 1970s and 1980s had led to increasing public resistance to the disposal of hazardous wastes – in accordance with what became known as the NIMBY (Not In My Back Yard) syndrome – and to an escalation of disposal costs. This in turn led some operators to seek cheap disposal options for hazardous wastes in Eastern Europe and the developing world, where environmental awareness was much less developed and regulations and enforcement mechanisms were lacking. It was against this background that the Basel Convention was negotiated in the late 1980s, and its thrust at the time of its adoption was to combat the "toxic trade", as it was termed. The Convention entered into force in 1992. Objective The overarching objective of the Basel Convention is to protect human health and the environment against the adverse effects of hazardous wastes. Its scope of application covers a wide range of wastes defined as "hazardous wastes" based on their origin and/or composition and their characteristics, as well as two types of wastes defined as "other wastes" - household waste and incinerator ash. Aims and provisions The provisions of the Convention center around the following principal aims: the reduction of hazardous waste generation and the promotion of environmentally sound management of hazardous wastes, wherever the place of disposal; the restriction of transboundary movements of hazardous wastes except where it is perceived to be in accordance with the principles of environmentally sound management; and a regulatory system applying to cases where transboundary movements are permissible.

#	Subject	Law	Website	Content (English)
				The first aim is addressed through a number of general provisions requiring States to observe the fundamental principles of environmentally sound waste management (article 4). A number of prohibitions are designed to attain the second aim: hazardous wastes may not be exported to Antarctica, to a State not party to the Basel Convention, or to a party having banned the import of hazardous wastes (article 4). Parties may, however, enter into bilateral or multilateral agreements on hazardous waste management with other parties or with non-parties, provided that such agreements are "no less environmentally sound" than the Basel Convention (article 11). In all cases where transboundary movement is not, in principle, prohibited, it may take place only if it represents an environmentally sound solution, if the principles of environmentally sound management and non-discrimination are observed and if it is carried out in accordance with the Convention's regulatory system. The regulatory system is the cornerstone of the Basel Convention as originally adopted. Based on the concept of prior informed consent, it requires that, before an export may take place, the authorities of the State of export notify the authorities of the prospective States of import and transit, providing them with detailed information on the intended movement. The movement may only proceed if and when all States concerned have given their written consent (articles 6 and 7). The Basel Convention also provides for cooperation between parties, ranging from exchange of information on issues relevant to the implementation of the Convention to technical assistance, particularly to developing countries (articles 10 and 13). The Secretariat is required to facilitate and support this cooperation, acting as a clearing-house (article 16). In the event of a transboundary movement of hazardous wastes having been carried out illegally, i.e. in contravention of the provisions of articles 6 and 7, or cannot be completed as foreseen, the Convention attributes responsibility to one or more of the States involved, and imposes the duty to ensure safe disposal, either by re-import into the State of generation or otherwise (articles 8 and 9). The Convention also provides for the establishment of regional or sub-regional centers for training and technology transfers

#	Subject	Law	Website	Content (English)
				regarding the management of hazardous wastes and other wastes and the minimization of their generation to cater to the specific needs of different regions and subregions (article 14). Fourteen such centers have been established. They carry out training and capacity building activities in the regions.
17	Environmental Safety: Waste Transport	SR 814.600 Technical Ordinance on Waste (TVA)	http://www.admin.ch/opc/de/classified-compilation/19900325/index.html	**Table of Content for linked document. Please use link to access full text.** Technical Ordinance on Waste (TVA) of 10 December 1990 (as at 1 July 2011) The Swiss Federal Council , having regard to Articles 29 , 30b , 30c , 30d , 30h , paragraph 1 , 39 paragraph 1 , 45 and 46, paragraph 2 of the Environmental Protection Act of 7 October 19831 (USG), 2 and Articles 9 paragraph 2, letter c , letter c 16 and 47, paragraph 1 of the Water Protection Act of 24 January 1991 decreed: 1 Chapter : Purpose and terms 2 Chapter: General rules on the darker and the treatment of waste 3 Chapter : Landfills 4 Chapter : Interim storage 5 Chapter : Waste incineration plants 6 Chapter : Composting plants 7 Chapter : Final provisions The Technical Ordinance on Waste obliges all producers of waste to collect separately and deposit accordingly different types of waste. This applies to households as well as industrial operations, including the erection, operation and maintenance of WTGs : Article 1 Purpose This Regulation shall : a protect people, animals, plants, their communities and the waters , protect the soil and the air from harmful effects or nuisances generated by waste ; b limit the impact on the environment caused by waste. 2 Scope of application

#	Subject	Law	Website	Content (English)
				This Regulation applies to the reduction and treatment of waste as well as the setup and operation of waste disposal facilities . Article 3 Definitions 1 Municipal waste originating from households wastes and other wastes of similar composition. 2 Hazardous waste is waste that is in the list of wastes pursuant to Article 2 of the Decree of 22 Was adopted in June 20051 on the marketing of waste (OMW) are designated as hazardous waste . 3 The treatment of waste applies their recycling, abatement or removal. Equivalent to treating the intermediate camps, collecting and transporting are not considered treatment. 4 Waste facilities are facilities where waste is treated. 5 landfills are waste facilities where waste is unloaded and finally controlled. 6 intermediate bearings are waste facilities where waste is unloaded, which have to be dealt with later in other ways. 7 excavation, overburden and excavated material is considered to be pollution-free if: a substance contained in it is in accordance with the limits do not exceed Annex 3 or not to be exceeded due to human activities , and b . it contains no foreign substances such as municipal waste , green waste and construction waste. Article 8 Hazardous waste 1 The cantons shall ensure that small quantities of hazardous waste from households and small businesses will be collected and treated separately. 2 They shall in particular for the establishment of collection and , if necessary, for the implementation of regular collections. Article 9 Construction waste 1 Who performs construction or demolition, hazardous waste must not be mixed with other waste and must inform the other waste on the construction site separate as follows:

#	Subject	Law	Website	Content (English)
				a pollution- excavation, overburden and excavated material; b . Wastes which may be deposited on inert materials without any further treatment; c . Combustible waste such as wood, paper, cardboard and plastics; d other waste.
18	Environmental Safety: Waste Water	Ordinance of 15 December 2006 on the Register relating to Pollutant Release and the Transfer of Waste and of Pollutants in Waste Water (PRTRO)	http://www.admin.ch/ch/e/rs/c814_017.html	**Table of Content gor linked document. Please use link to access full text.** Ordinance on the Register relating to Pollutant Release and the Transfer of Waste and of Pollutants in Waste Water (PRTRO) of 15 December 2006 (Status as at 23 January 2007). The Swiss Federal Council, based on Article 46 paragraph 2 of the Federal Act of 7 October 19831 on the Protection of the Environment (EPA), ordains: Section 1: General Provisions Art. 1 Aim and scope of application Art. 2 Definitions Section 2: Duties of the Facility Owner or Operator Art. 3 Duty of care Art. 4 Reporting requirement Art. 5 Content of the report Art. 6 Retention obligation Section 3: Duties of the Authorities Art. 7 Maintaining the PRTR Art. 8 Information to the general public Art. 9 Confidentiality Art. 10 Verification of data Art. 11 Advice to the general public and cooperation with the Cantons

#	Subject	Law	Website	Content (English)
				Section 4: Final Provisions Art. 12 Amendment of current law Art. 13 Transitional provisions Art. 14 Commencement Annex 1 (Art. 1 para. 2) - Installations Annex 2 - Pollutants Annex 3 - Disposal and recovery operations - 1. Disposal operations (“D”) - 2. Recovery operations (“R”)
19	Fire Protection	Fire Protection Norm v1.03d of 20 October 2010	http://www.praever.ch/de/bs/vs/norm/Seiten/Norm_.pdf	**Table of Content for linked document. Please use link to access full text.** A OBJECTIVES AND PRINCIPLES Article 1 Purpose Article 2 Scope of application Article 3 Affected Article 4 General outline Article 5 b Fire safety standard Article 6 c Fire regulations Article 7 d Inspection Article 8 s State of the art Article 9 Protection goal Article 10 Criteria for fire protection requirements Article 11 Normal cases and deviations Article 12 Definitions Article 13 Fire risk assessment , recognized calculation methods Article 14 Application and approval a general Article 15 b Mark Article 16 c Without test certificate or certificate B GENERAL FIRE PROTECTION Article 17 Duty of Care Article 18 Maintenance obligation

#	Subject	Law	Website	Content (English)
				Article 19 Duty of supervision Article 20 Reporting requirement C. Structural fire protection C1 Building Materials Article 21 term Article 22 Examination and Classification Article 23 Use C2 components Article 24 term Article 25 Audit and classification C3 separation distances Article 26 term Article 27 Rated Article 28 Insufficient safety distances C4 Structures Article 29 term Article 30 Fire resistance Article 31 Proof C5 fire sections 11 Article 32 terms Article 33 Creation duty Article 34 Fire resistance Article 35 fire protection closures , penetrations Article 36 buildings with double facades, Atriumbauten C6 escape routes 12 Article 37 term Article 38 arrangement Article 39 measuring way Article 40 escape route in space Article 41 of the total length of the escape route Article 42 stairs a number and location Article 43 b version Article 44 exterior stairs

#	Subject	Law	Website	Content (English)
				Article 45 stairs Article 46 corridors , execution Article 47 width of staircases , corridors , doors Article 48 doors Article 49 expansion Article 50 of free entertainment Article 51 Identification, Security lighting Article 52 high-rise buildings Article 53 buildings with double facades, Atriumbauten D TECHNICAL FIRE PROTECTION 15 Article 54 term Article 55 task Article 56 need Article 57 preparation and operational readiness E DEFENSE LOWER FIRE PROTECTION 16 Article 58 Access for firefighters Article 59 alert and operational concepts Article 60 fire brigade F HOUSE PLANT 16 Article 61 term Article 62 preparation and operational readiness G SUBSTANCES 17 Article 63 term Article 64 Classification Article 65 of the protective measures Article 66 Stoffseparierung Article 67 Special rooms and zones Article 68 of the container H OPERATING FIRE PROTECTION 17 Article 69 purpose Article 70 Security Officers Article 71 fire protection and fire fighting plans Article 72 Safety on construction sites Article 73 decorations

#	Subject	Law	Website	Content (English)
				I IMPLEMENTATION 18 Article 74 Monitoring and controls J FINAL DETERMINATION 18 Article 75 entry into force
20	Fire Protection	Fire safety guidelines	http://www.praever.ch/de/bs/vs/richtlinien/Seiten/default_richtlinien.aspx	**Table of Content for linked document. Please use link to access full text.** Comprehensive list of all currently valid fire safety guidelines: Fire prevention - safety in factories and on construction sites Building Materials and Components Use of combustible building materials Structures Separation distances - fire sections (Status as of 20.10.2008) Escape and rescue routes (Status as of 20.10.2008) Marking of escape routes - Security lighting - safety power supply (Status as of 20.10.2008) Fighting equipment Sprinkler "Valid until 31.05.2011" Sprinkler "Valid from 01.06.2011" Fire alarm systems "Valid until 31.05.2011" Fire alarm systems "Valid from 01.06.2011" Gas Alarm Systems Smoke and heat extraction systems Lightning protection systems The lift equipment (Status as per 20.10.2008) Heat engineering installations Ventilation Systems Hazardous substances Flammable liquids

#	Subject	Law	Website	Content (English)
21	Fire Protection	Fire safety regulations	http://www.vkf.ch/VKF/Services/Brandschutzvorschriften.aspx	**Translation of relevant content. Use link to access full document.** Mandatory fire safety regulations for Switzerland The Swiss fire regulations intended to protect people, animals and property from the dangers and effects of fires and explosions. They are established at national level and are legally binding in all cantons. Fire regulations consist of the fire safety standard and the fire safety guidelines. The standard contains principles for the construction, technical and operational fire protection. The guidelines define individual measures in the context of the fire safety standard.
22	Fire Protection	Fire protection procedures	http://www.praever.ch/de/bs/vs/verzeichnisse/Seiten/41-03_web.pdf	**Table of Content for linked document. Please use link to access full text.** Comprehensive list of all fire ssafety related requirements that must be observed in addition to the fire safety regulations and guidelines: 1 Introduction 2 Assignment of decrees and publications on VFK fire regulations 2.1 Fire prevention - safety in factories and on construction sites (BSR 11-03) 2.2 Building Materials and Components (classification) (BSR 12-03) 2.3 Use of combustible materials (BSR 13-03) 2.4 Structures (BSR 14-03) 2.5 Safety distances - fire sections (BSR 15-03) 2.6 Escape and rescue routes (BSR 16-03) 2.7 Marking of escape routes - Security Lighting - Security Power Supply (BSR 17-03) 2.8 Firefighting equipment (BSR 18-03) 2.9 Sprinkler (BSR 19-11) 2:10 Fire alarm systems (BSR 20-11) (...)

#	Subject	Law	Website	Content (English)
				4 Abbreviations
23	Labeling of Heavy Goods in Transport	SR 832.311.18 Federal law of 28 March 1934 on the Labeling of heavy goods for transport and shipment.	http://www.admin.ch/opc/de/classified-compilation/19340027/193410010000/832.311.18.pdf	**Translation of content. Use link to access the document.** 832.311.18 Federal law of 28 March 1934 on the labeling of heavy goods for transport and shipment. The Federal Assembly of the Swiss Confederation , having regard to Article 34ter of the Federal Constitution 1, and having considered the Federal Council Dispatch dated 24 November 1933 , decrees: Article 1 1 cargo or other items of 1000 kg or more gross weight, which are passed in the territory of the Swiss Confederation for the transport and destined for shipment at sea or on inland waterways have provided on the outside with a comprehensible and indelible label their gross weight in kilograms be . 2 the exact weight of peculiar reasons, cannot be ascertained, exceptionally, the approximate weight is indicated, but it must be clearly evident in this case that the weight are an approximate only . Article 2 1 The weight designation shall be placed before the shipment is made to a ship and cargo before the piece leaves the territory of the Swiss Confederation. 2 to indicate the name of the sender weight and its agents are responsible. Article 3 1 Unpackaged bulk goods not covered by this law. 2 Likewise, except for transit goods, if they are unable to run due to new freight documents from Switzerland. Article 4 1 The supervision of the implementation of this Act is whether the cantons, they call the law enforcement agencies. 2 The Federal Council has the ultimate supervision. He may require the cantons reports on the implementation.

#	Subject	Law	Website	Content (English)
				Article 5 1 Anyone who willfully or negligently fails to affix the prescribed in Articles 1 and 2 weight designation, shall be liable to a fine of 500 francs. 2 The general provisions of the Federal Act of 4 February 18531 on the Federal criminal law shall apply. 3 The prosecution and judgment of offenses is up to the cantons Article 6 1 The Federal Council shall determine the effective date of this Act. 2 It is charged with its full course. Date of entry into force : 1 October 1934
24	Noise Emission Control (during installation of offshore foundations and operations of WTGs)	SR 814.41 Noise Abatement Ordinance of 15 December 1986 (NAO)	http://www.admin.ch/ch/e/rs/814_41/index.html	**Translation of relevant content. Use link to access full document.** Noise Abatement Ordinance (NAO) of 15 December 1986 (Status as of 1 August 2010) The Swiss Federal Council, on the basis of Articles 5, 12 paragraph 2, 13 paragraph 1, 16 paragraph 2, 19, 21 paragraph 2, 23, 39 paragraph 1, 40 and 45 of the Federal Act of 7 October 19831 on the Protection of the Environment (the Act), ordains: Chapter 1: General Provisions Art. 1 Aim and scope Art. 2 Definitions Chapter 2: Vehicles, Mobile Appliances and Machines Section 1: Emission Limitation Measures from Vehicles Art. 3 Section 2: Emission Limitation Measures for Mobile Appliances and Machines

#	Subject	Law	Website	Content (English)
				Art. 4 Principles Art. 5 Conformity assessment and marking of equipment and machines Art. 6 Regulations on noise from building sites Chapter 3: New and Modified Stationary Installations Art. 7 Emission limitation measures for new stationary installations Art. 8 Emission limitation measures for modified stationary installations Art. 9 Increased demand on transport facilities Art. 10 Soundproofing measures in existing buildings Art. 11 Costs Art. 12 Inspection Chapter 4: Existing Stationary Installations Section 1: Improvements and Soundproofing Measures Art. 13 Improvements Art. 14 Relaxation of the requirements for improvements Art. 15 Soundproofing measures for existing buildings Art. 16 Costs Art. 17 Time limits Art. 18 Inspection Art. 19 Art. 20 Periodical surveys Section 2:2 Federal Subsidies for Improvements and Soundproofing Measures on Existing Trunk Roads and Other Roads Art. 21 Eligibility for subsidies Art. 22 Application Art. 23 Programme agreement Art. 24 Determination of the subsidy Art. 24a and Art. 24b Art. 25 Payment Art. 26 Reports and controls Art. 27 Inadequate fulfilment and misuse of subsidies Art. 28 Chapter 5: Requirements for Building Zones and Planning Permission in Areas exposed to Noise

#	Subject	Law	Website	Content (English)
				Art. 29 Designation of new building zones and new zones with higher noise abatement requirements Art. 30 Development of building zones Art. 31 Planning permission in areas subject to noise Chapter 6: Soundproofing of New Buildings Art. 32 Requirements Art. 33 External building elements, partitions and building facilities Art. 34 Application for planning permission Art. 35 Inspections Chapter 7: Investigation, Assessment and Control of Exposure to Exterior Noise due to Stationary Installations3 Section 1: Investigation Art. 36 Obligation to investigate Art. 37 Noise pollution register Art. 37a Determination and control of noise exposure levels Art. 38 Method of determination Art. 39 Point of determination Section 2: Rating Art. 40 Exposure limit values Art. 41 Validity of the exposure limit values Art. 42 Special exposure limit values for rooms in industrial buildings Art. 43 Sensitivity levels Art. 44 Procedures Chapter 8: Final Provisions Section 1: Enforcement Art. 45 Responsibilities of the Confederation and the cantons Art. 45a National noise pollution survey Art. 46 Geo-information Section 2: Transitional Provisions Art. 47 Stationary installations and buildings Art. 48

#	Subject	Law	Website	Content (English)
				Art. 48a Improvements and soundproofing measures for roads Art. 49 Section 3: Commencement Art. 50 Annex 1 - Requirements for Soundproofing of Windows Annex 2 - Requirements for the Calculation Procedures and Measuring Instruments Annex 3 - Exposure Limit Values for Road Traffic Noise Annex 6 - Exposure Limit Values for Industrial and Commercial Noise AS 1987 338 1 SR 814.01 2 Amended by No I 14 of the Ordinance of 7 Nov. 2007 on the New System of Fiscal Equalization and Division of Tasks between the Confederation and the Cantons, in force since 1 Jan. 2008 (AS 2007 5823) 3 Amended by No I of the Ordinance of 1 Sept. 2004, in force since 1 Oct. 2004 (HYPERLINK "http://www.bk.admin.ch/ch/d/as/2004/4167.pdf") Wording of sentence according to No I of the Ordinance of 12 April 2000 (HYPERLINK "http://www.bk.admin.ch/ch/d/as/2000/1388.pdf")

#	Subject	Law	Website	Content (English)
25	Noise Pollution	Federal Office for the Environment (BAFU / FOEN) Guidelines on Structural and operative measures for the limitation of building noise (according to article 6 of the SR 814.41 Noise Abatement Ordinance)	http://www.bafu.admin.ch/publikationen/publikation/00006/index.html?lang=en	**Overview of content. Please use link to access full text.** The Guidelines on building noise entered into force on 2 February 2000. They spell out Article 6 of the Noise abatement ordinance of 15 December 1986 in concrete terms. The Article requires the Federal Office for the Environment to issue guidelines on structural and operative measures for the limitation of building noise.
26	Pressure Equipment	Federal Office for Health and Safety at the Workplace (EKAS) Directive on Safe use, inspection and maintenance of	**Error! Hyperlink reference not valid.**	**Table of Content for linked document and translation of relevant article(s). Please use link to access full text.** Content 1 Legal Basis 2 Purpose 3 Scope 4 Terms 5 Reporting requirement

#	Subject	Law	Website	Content (English)
		pressure equipment		6 Principles 7 Description of the recurring inspections 7.1 General 7.2 Inspection during operation 7.3 Inspection at a standstill 7.4 Other test methods 7.5 Inspection of safety valves 7.6 Inspection of functional safety systems 7.7 Special Cases 8 Implementation of recurring inspections 8.1 Inspection during operation 8.2 Inspection at a standstill 8.3 Safety Valves 8.4 From operation to be performed inspections during operation 8.5 classification of holdings, perform the inspections on pressure equipment 8.6 Additional tasks of the inspection body 9 Exemption from inspection requirement 10 Repairs and alterations 11 adoption Appendix

#	Subject	Law	Website	Content (English)
27	Safety at Work	Federal Office for Health and Safety at the Workplace (EKAS) Directive 6509 on the Involvement of occupational physicians and other occupational safety specialists	http://www.ekas.admin.ch/index-de.php?frameset=200	**Full Table of Content for linked document. Please use link to access full text.** EKAS Directive 6508 Involvement of occupational physicians and other occupational safety specialists Contents Preface: What you need to observe 1 Purpose 2 Involvement of occupational physicians and other occupational safety specialists 3 Implementation 4 Tasks of the occupational safety specialists 5 Industry, operation group, model solution (inter-company solutions) 6 Representation participation from employees or that of its 7 Implementation 8 Adoption Attachments Appendix 1 Special Hazards Appendix 2 Main tasks of the occupational safety specialists Appendix 3 Subsidiary Model Appendix 4 Definitions and explanations Appendix 5 Relevant legal texts

#	Subject	Law	Website	Content (English)
28	Smoking	SR 818.31 Federal Act on the Protection against passive smoking	http://www.admin.ch/opc/de/classified-compilation/20071656/index.html	**Translation of introductory article(s). Please use link to access full text.** SR 818.31 Federal Act on Protection against passive smoking of 3 October 2008 (as of 1 May 2010) The Federal Assembly of the Swiss Confederation, based on the article 110 paragraph 1 letter a and 118 paragraph 2 letter b of the Federal Constitution1, having considered the Commission for Social Security and Health of the National Council from 1 review June 20072 and in the opinion of the Federal Council of 22 August 20073, decrees: Article 1 Scope 1 This Act regulates the protection against passive smoking in enclosed spaces that are open to the public or serve more people than work. 2 Publicly accessible rooms are in particular: a building of public administration; b. Hospitals and other health care facilities; c. Children's homes, retirement homes and similar institutions; d facilities of sentences and measures implementation; e educational institutions; f museum, theater and cinema premises; g sports venues; h catering and hotel businesses (including non-agricultural secondary establishments under Article 24b of the Spatial Planning Act of 22 June 19791) is independent of cantonal licensing requirements; i buildings and public transport vehicles; j. Sale of shops and shopping centers. 3 In private households, this law is not applicable. Article 2 Smoking ban 1 Smoking is prohibited in rooms according to Article 1, paragraphs 1 and 2. 2 The operator or the operator or the person responsible for the house rules may in special rooms where no workers or workers are

#	Subject	Law	Website	Content (English)
				employed that allow smoking, if they separated, specially marked and provided with adequate ventilation are (smoking rooms). Exceptionally workers or workers may be busy with their express consent in smoking areas of catering and hotel businesses. The agreement shall be made in the context of the employment contract. 3 The Federal Council shall adopt specific rules on the nature of smoking rooms and the ventilation requirements. He also enters into an arrangement for forced whereabouts and facilities that serve the continuous storage or a longer stay.
29	Smoking	SR 818 311 Regulation on the protection against passive smoking	http://www.admin.ch/opc/de/classified-compilation/20090967/index.html	**Translation of full document.** 818 311 Regulation on the protection against passive smoking (secondhand smoke protection regulation, PaRV1) of 28 October 2009 (as of 1 May 2010) The Swiss Federal Council, having regard to Articles 2, paragraph 3, and 6, paragraph 1 of the Federal Act of 3 October 20082 for protection against passive smoking, prescribed: 1 Section: General Provisions Article 1 Scope This Ordinance regulates: a smoking ban in enclosed spaces that are open to the public or serve more people than work; b. the requirements for smoking rooms and their ventilation; c. the demands on smoking and offer to their ventilation; d the requirements for the employment of workers or workers in smoking rooms and smoking bars; e the exceptions to the ban on smoking in forced residence and facilities that serve the continuous storage or a longer stay. Article 2 smoking ban 1 Smoking is prohibited, subject to Article 4-7 in enclosed spaces that are open to the public or serve more people than work.

#	Subject	Law	Website	Content (English)
				2 As a work of several persons shall be any place where several workers or workers must reside permanently or temporarily to perform their assigned work. Article 3 duty of care Anyone who operates a room where smoking is permitted, must ensure that people are being harassed in adjacent smoke-free rooms not smoke. 2 Section: smoking and smokers Local Article 4 requirements for smoking rooms 1 The operator or the operator or the person responsible for the house rules must ensure that the smoking room: is separated by a dense solid components from other spaces, not used as a passageway to other rooms and has an automatically closing door; b. is provided with sufficient ventilation. 2 Smoking rooms must be clearly marked and in a conspicuous place at each entrance as such. 3 With the exception of tobacco products and smokers' requisites, no benefits may be offered in a smoking room, which are not available in other operating. 4 For smoking in a restoration or hotel operations also apply: a. its area shall not exceed one third of the total area of the dispensing rooms; b. their opening times should not be longer than in the rest mode. Article 5 Requirements for smoking establishments 1 A restoration operations are approved by the competent cantonal authority, on application, as smoking establishment if: a the total area of the open to the public rooms, including entrance hall, cloakroom and toilets, more than 80 square meter; b. The restaurant is equipped with sufficient ventilation. 2 smoking establishments shall be clearly labeled and in a conspicuous place at each entrance as such. May be performed as three non-smoking restaurant:

#	Subject	Law	Website	Content (English)
				a premises or establishments which primarily serve the meals at work as staff restaurants or canteens; b. Companies whose main activity is not in the hospitality area, except for non-agricultural establishments in accordance with Article 24b of the Spatial Planning Act of 22 June 19791st Article 6 employment of workers or workers in smoking rooms and smoking bars 1 In-smoking areas of catering and hotel businesses and places in smoking workers or workers may only be employed if they have agreed in writing. 2 workers may be employed in smoking areas for testing of tobacco products unless they have consented to such action in writing. 3 For pregnant women, nursing mothers and young people under the age of 18, the special protection provisions of the Labour Act of 13 apply March 19641 and its implementing regulations. 3 Section: Special facilities Article 7 1 The operator or the operator or the person responsible for the house rules may provide that smoking is allowed in rooms: a of institutions of criminal and enforcement measures or similar institutions; b. of nursing homes or similar institutions; c. of hotels or other lodging facilities. 2 people, located in a facility referred to in paragraph 1 letter a or b, may require to be accommodated in a room with no smoking. (...)

#	Subject	Law	Website	Content (English)
30	Soil Pollution	814.12 Soil Pollution Ordinance (SoilPO)	http://www.admin.ch/opc/de/classified-compilation/19981783/index.html#	**Table of Content for linked document and translation of relevant article(s). Please use link to access full text.** Ordinance on Soil Pollution (OIS) of 1 July 1998 (As at 1 June 2012) The Swiss Federal Council , having regard to Articles 29, 33 paragraph 2, 35 paragraph 1 and 39 paragraph 1 of the Environmental Protection Act of 7 October 19831 (USG) , prescribed: 1 Section : purpose, the scope and terms Article 1 Purpose and object For long-term maintenance of soil fertility , this Regulation : a the observation , monitoring and assessment of the chemical, biological and physical contamination of soils ; b . the measures to prevent sustainable soil compaction and erosion; c . which measures the handling of excavated soil; d the broader measures of the cantons in contaminated soils (Art. 34 USG) . 2 Definitions 1 floor is considered to be fruitful if: a it has a typical location for his species-rich, biologically active community and typical soil structure, and an undisturbed degradability; b. to natural and human -influenced plants and plant communities grow and evolve undisturbed and their characteristic properties are not impaired ; c. crop products have good quality and not endanger the health of humans and animals ; d people and animals who receive him directly, are not endangered. 2 Chemical soil loads are loads of soil through natural or artificial substances (pollutants) .

#	Subject	Law	Website	Content (English)
				3 Biological soil impacts are impacts on the soil , particularly by genetically modified , pathogenic or non-resident Organismen.1 4 Physical soil impacts are impacts on the soil by artificial changes in the structure of the building or the thickness of the soil. 5 test values indicate for certain uses, impacts on the soil , humans, animals or plants may be specifically at risk if exceeded, according to the state of science and experience. They are used to assess whether restrictions on the use of the land under Article 34 , paragraph 2 USG are necessary. 1 Amended in accordance with Annex 5, para. 9 of the Ordinance of 9 March 2012, in force since 1 June 2012 (AS 2012 2777) . 2 Section : Monitoring, surveillance and assessment of soil pollution (...) 3 Section : Prevention of sustainable soil compaction and erosion; handling of excavated soil (...) 4 Section : Any further measures in contaminated soils (...) 5 Section : recommendations of the Federal (...) 6 Section: Final provisions (...)
31	Crane operations	Federal Office for Health and Safety at the Workplace (EKAS) Directive	http://www.ekas.admin.ch/index-de.php?frameset=200	**Full Table of Content for linked document. Please use link to access full text.** EKAS Directive 6510 on Crane operator training and qualifications for vehicle and tower cranes (CFST) Contents

#	Subject	Law	Website	Content (English)
		6510 on Crane operator training and qualification		1 Introduction 1.1 Legal Basis 1.2 Purpose 1.3 Terminology Perform two centers, the basic courses and exams 2.1 Contents of the Basic Course Regulations 2.2 Content of the Examination Regulations 2.3 Qualification of trainers 2.4 Qualification of examiners 3 Personal Fitness 3.1 confirmation for teenagers 3.2 confirmation for the remaining candidates 3.3 Health reservations 3.4 Submission and return of the confirmation 4 basic training 4.1 Selection time 4.2 Basic Course 4.3 Practice time. 4.4 Review 5 Cards 5.1 Principles 5.2 Learner's permit 5.3 Crane driving license 6 Adoption Appendix 1: crane Images Annex 2: Rules for the crane operator testing
32	Crane use	SR 832.312.1	http://www.admin.ch/	**Full translation of main body of text of document referred to.**

#	Subject	Law	Website	Content (English)
		5 Regulation of 27 Septembe r 1999 (as of July 1, 2010) on the Safe use of cranes (Crane Regulation)	opc/de/classified-compilation/19995603/index.html	SR 832.312.15 Regulation) of 27 September 1999 (as of July 1, 2010) on the Safe use of cranes (Crane Regulation) The Swiss Federal Council , having regard to Article 83 , paragraph 1 of the Accident Insurance Act of 20 March 19811 (LAA) , decrees: 1 Chapter One: General Provisions Article 1 Subject matter 1 This Regulation defines which measures for the safety of the workers are taken with the use of cranes. 2 Where this Regulation provides nothing special, the Ordinance of 19 applies December 19832 the Prevention of Accidents (VUV). Article 2 Cranes 1.As cranes within the meaning of this Regulation, lifting devices , which have the following characteristics : a. The load capacity of the crane hook is at least 1000 kg load torque less than 40 000 Nm. b. The device has a motor-driven hoist . c . The crane hook can be moved horizontally freely in at least one axis. 2 The cranes are divided into the following categories : a Mobile cranes such as mobile cranes, mobile cranes, crawler cranes, trailer cranes, equipped with winch rail cranes and telescopic forklifts and truck cranes with a load torque of more than 400 000 Nm or a boom length of more than 22 m; b Tower cranes c other cranes like gantry cranes, bridge cranes, jib cranes , cranes , equipped with no winch rail cranes and telescopic forklifts and truck cranes with a load torque of 000 Nm at most 400 and a boom length of more than 22 m. 3 are not considered as Cranes: a Devices for the lifting of persons ; b Construction , whose equipment are designed for earthmoving and equipped with a lifting hook . Article 3 Crane documents and declaration of conformity 1 Each crane has a crane book. For cranes that after 31 December have been placed on the market in 1996 , in addition the

#	Subject	Law	Website	Content (English)
				manufacturer's declaration of conformity is identified by Article 9 of the Ordinance of 19 May 20102 on product safety . These documents are stored so that they are seen by the relevant executive body under Articles 47-51 VUV3 (executive body) , at the request können. The two crane must as a minimum include the following : a Name and address of the manufacturer; b Designation of series or type; c Serial number ; d year of manufacture; e the basic technical data, in particular dimensions, weights, loads and possible set-ups . 3 In the Crane book are also provided in chronological order, starting with the date, name and signature , enter : a the results of the checks referred to in Article 15; b the maintenance and modification work ; c the locations and the associated set-ups , except for mobile cranes in accordance with Article 2, paragraph 2 letter a and at truck loading cranes , railway cranes and telehandlers under Article 2, paragraph 2 letter c ; d extraordinary events , related to the security of the crane ; e the crane owner. 2 Chapter: Use of cranes Article 4 Principles 1 Cranes may only be operated in a safe condition . It shall be transported, set up , maintain and dismantle that people are not endangered. The manufacturer's instructions must be observed. 2 The assembly and disassembly of cranes and maintenance services of cranes may be performed only by persons who are trained. 3 Before cranes are used in the vicinity of current carrying bare electrical conductor or of railway facilities, are to be agreed, the additional protective measures to be taken with the lead owners or the railway companies. Cannot agree, the parties, the implementing body must be informed. 4 is restricted by obstacles of the action range of cranes, are protective measures to prevent collisions taken. 5 The transport of people with cranes that are not expressly

#	Subject	Law	Website	Content (English)
				provided for by the manufacturer is prohibited. Where special circumstances make such transportation necessary to have a special permit by the Swiss Accident Insurance Fund (SUVA) within the meaning of Article 69 VUV1 must be obtained in advance. Article 5 Requirements on the operator 1 Lifting Working with cranes should be carried out by persons who: a due to their physical and mental condition to ensure safe operation of the crane ; b able to communicate in the workplace; c are being instructed in the operation of the benützten crane. 2 lifting work with vehicle and tower cranes must be performed only by persons who have one of the following cards: a Crane driver's license ; b Learner's permit for the selection of time when the learner or by a person who owns a crane driver's license for at least three years , or is accompanied by a supervisor appropriate for the job work experience; c Learner's permit for the practice time , or when the learner from a person who owns a crane driver's license for at least three years , or supervises a supervisor with appropriate experience for this task wird.1 3 No disclosure is required in lifting work carried out within the framework of basic courses and exams werden.2 Article 6 Requirements on the operator in lifting work 1 loads are to be secured for the lifting operation so as to attach the crane hook (to strike) and turn off after the lifting operation so that they fall over not -making in risk way , fall down or may slip off. 2 lifting equipment and lifting accessories must be suitable for the particular transport and in safe operating condition. 3 people that strike loads are to lead to this work. Article 7 Requirements for a third crane operator Who can make the crane by a third-party companies available, is responsible for ensuring that the provisions of this Regulation are complied with, provided that the undertakings concerned do not agree in writing anything to the contrary .

#	Subject	Law	Website	Content (English)
				Chapter 3: Crane driver's licenses and crane operator training Section 1: Crane driver's licenses Article 8 Categories Crane driver's licenses are issued for the following categories: a Category A: for mobile cranes; b Category B: for tower cranes. Art 9 Issuance of a learning permit 1 The learner's permit is replaced by anyone who: a the 17th Age years old; b due to the physical and mental condition brings the prerequisites for a safe operation of the crane and is able to communicate in the workplace, young people under the age of 18 must conduct an entrance examination under Article 72 VUV2 . 2 people who come for training as a crane operator or crane operator considered and their suitability to be tested for this activity, get the learner's permit for the selection time. The card will, on application, once granted and limited to two months. 3 people who have completed the basic course in accordance with Article 12, paragraph 1 with success and want to prepare for the upcoming test, get the learner's permit for the practice time. The card shall be unique on application and duration of ten months. If the test is not passed, the learner's permit from test date may be extended at most twice by six months. 4 The learner's license for the practice period may also be extended at the written and reasoned request, according to illness, accident , pregnancy, military , civil , or civil defense service . Article 10 Grant of the crane driver's license The crane driver's license Class A or B shall be granted to persons who: a the 18th Age years of age; b due to the physical and mental condition can ensure a safe operation of the crane ; c training as a crane operator or crane operator pursuant to Article 12 or equivalent have been successfully completed .

#	Subject	Law	Website	Content (English)
				Article 11 Responsibility for granting and withdrawal of certificates 1 The crane driver's licenses and learning passes are issued by the SUVA. 2 The passes will be withdrawn by the SUVA if: a which no longer exist on the issue ; b the holder of the ID card , the rules on the prevention of accidents intentionally or negligently injured. Section 2: Crane operator training Art 121 General 1 The training necessary to obtain a crane driver's license includes a basic course and an examination. 2 Anyone who owns a crane driver's license of a category can compete without renewed basic course to check the other category. Art 131 Basic training and tests 1 The basic courses and exams have the following contents : a for the crane Category A: setting up of mobile cranes at work and their operation ; b for the crane Category B: the operation of tower cranes ; c the fastening of loads in theory and practice ; d the rules of occupational safety and health requirements for the operation of cranes ; e the rights and obligations of the crane operator or the crane operator ; f the inspection and maintenance of cranes by the crane operator or the crane operator . 2 The test may be repeated twice. Art 141 Recognition of basic courses and exams 1 schools that offer a guarantee that they meet the requirements of Article 13 permanently, their basic courses and examinations by the Swiss Accident Insurance Fund (SUVA) can recognize. 2 You must submit a written , Worded in an official Swiss language request , stating in particular from the SUVA : a which parts are offered the courses for which category Cranes; b the curriculum and the Basic Course Regulations ; c the examination syllabus and the examination regulations;

#	Subject	Law	Website	Content (English)
				d the qualifications of the trainers and instructors ; e the qualifications of the examiners and examiners ; f the organization and financing of basic courses and exams. 3 Represents the SUVA finds that the conditions for recognition are no longer met, it may withdraw the recognition. 4 The SUVA has launched a public list of approved basic courses and exams. Chapter 4: Control Section 1: Crane controls Article 15 1 The employer or the employer has the cranes can be regularly according to the recognized rules of engineering control as to their operational condition or shall ensure that these checks have been performed. 2 The checks must be performed by persons who are trained. 3 To carry out the checks at mobile cranes and tower cranes a crane expert or a crane expert within the meaning of Article 16 paragraph 1 must be consulted. 4 The Coordination Commission shall issue guidelines on the intervals, the scope and method of the controls. Section 2: crane experts and experts Article 16 Recognition 1 The SUVA recognizes people as a crane expert or experts who: a have a federal certificate for maintenance professionals or an equivalent certificate ; b at least five years of professional experience in the field of assembly, disassembly and maintenance can prove of mobile cranes or tower cranes , and c Have experience in electrical engineering and , in the ordinary crane control technology. The two crane experts and experts must be adequately receive training in the necessary experts for their activity fields, particularly in the areas of maintenance and crane technology. 3 The SUVA may withdraw a crane expert or a crane expert recognition if:

#	Subject	Law	Website	Content (English)
				a the conditions for recognition have ceased to exist ; b the crane or the crane expert the provisions of this Regulation, in particular in the exercise of expert activity , not followed. 4 The SUVA has launched a public list of approved crane experts and experts. Article 17 Position relative to the operating business entity 1 The employer or the employer has to create the conditions so that the crane experts and experts can do their job. These have to orient the employer or the employer of their activities. 2 The crane experts and experts must possess the necessary to perform its task independence be granted. From the performance of their task not prejudice may arise. Article 18 position relative to the SUVA (=Swiss Federal Accident Insurer) 1 The crane experts and experts must SUVA on demand on their inspection activities provide information and submit their documents for inspection. The SUVA informs the employer or the employer about it. 2 The SUVA advises and assists the crane experts and experts. 3 The crane experts and experts must SUVA notified immediately when an immediate and serious danger to the life and health of the workers there and if the employer or the employer refuses to take the necessary measures. Art 18a Guidelines for the Coordination Commission The Coordination Commission pursuant to Article 85, paragraph 2 LAA shall issue guidelines in accordance with Article 52a VUV2 to implement this Regulation. Chapter 5: Legal Article 191 Dispositions of SUVA in accordance with Articles 11, 14 and 16 are subject to appeal in accordance with the general provisions on the administration of federal justice. Chapter 6 : Final provisions Article 20 Transitional provisions for crane leaders and crane

#	Subject	Law	Website	Content (English)
				operator 1 Anyone who has purchased a professional career as a crane operator or crane operator before the entry into force of this Regulation , can gain the learner's permit without having previously attended a basic course in accordance with Article 13, paragraph 1. Can a professional experience of more than five years are detected, the learner's permit with a validity of up to 31 is Issued in December 2004. The crane operator exam can be taken only after the visit of the basic course of the relevant category. 2 Who before 1 July 2000 has obtained a certificate recognized by a cantonal or communal authority crane driver's license or an equivalent certificate, may apply for a crane with SUVA driving license category A or B. Article 10 letter b remains vorbehalten. Article 21 Transitional provisions for crane experts and experts 1 Who has acquired a professional experience of at least 25 years in the field of erection, dismantling and maintenance of mobile cranes or tower cranes as well as experience in electrical engineering and, in the ordinary crane control technology before the entry into force of this Regulation, is, or upon application by SUVA as a crane expert - recognized expert. 2 Who has acquired a professional experience of at least ten years in the field of erection, dismantling and maintenance of mobile cranes or tower cranes, a technical training and experience in electrical engineering and, in the ordinary crane control technology before the entry into force of this Regulation shall, on application, to the 30 June 2003 without additional training continues to be recognized as a crane expert or expert by SUVA. Art 21a1Übergangsbestimmung amending of 5 September 2007 For crawler cranes, trailer cranes, equipped with winch rail cranes and telescopic forklifts and truck cranes with a load torque of more than 400 000 Nm or a boom length of over 22 meters the requirements of 5, paragraph 2 and 15 paragraph 3 shall apply according to Article from 1 January 2010. Article 22 Repeal of current legislation The Order of 22 June 19511 on the prevention of accidents in the use of cranes and hoists shall be repealed.

#	Subject	Law	Website	Content (English)
				(...) Article 24 Entry into force 1 This Regulation shall, subject to paragraph 2 on 1 January 2000. 2 Article 5, paragraph 2 shall apply from 1 January 2001.
33	Cranes	Guidelines (SUVA) on Access to Cranes	**Error! Hyperlink reference not valid.**	**Translation of relevant content. Use link to access full document.** For industrial cranes raises again the question of whether walkways or maintenance platforms are necessary for the safe maintenance. This factsheet is intended to enable a tool for the assessment of the local situation. The maintenance of crane equipment includes assemblies such as trolley with hoist and trolley, crane carrier with chassis, control , regulating and control devices , control switches , power supply and crane runway . The inspection intervals for the individual modules are different. For further details see the manufacturers have to be documented in the operating and maintenance instructions. -- The Machinery Directive 2006/42/EC describes the principle of maintenance as follows: 1.6.2. Access to operating positions and servicing points to engage The machinery must be designed and constructed so that all locations that need to be accessible for operation , adjustment and maintenance of the machinery , can be achieved safely . 1.7.4.2. Contents of this manual: instructions for safely setting up and maintaining including that should be taken protective measures. -- In the risk assessment, the manufacturer must identify the hazards and the associated hazardous situations. The identified risks must be minimized to be - side or as far as possible. There are to take necessary protection measures, or the user is adequately trained

#	Subject	Law	Website	Content (English)
				and it is to use the personal protective equipment. Work locations Maintenance and repair work on the cranes need to be carried out on safe work locations. When tools such as work platforms and the like may not always be installed securely to the necessary facilities are attached to the crane itself. Secure work locations for maintenance and repair of cranes are: • fixed on the crane mounted platforms • fixed to the building mounted platforms • mobile work locations (aerial work platforms, scaffolding , etc.) according to the following conditions .
34	Electrical and electronic equipment	SR 814.620 Ordinance on the Return, Take-Back and Disposal of Electrical and Electronic Equipment (ORDEE)	http://www.admin.ch/opc/de/classified-compilation/19980114/index.html	**Translation of relevant content. Use link to access full document.** Ordinance on the Return, Take-Back and Disposal of Electrical and Electronic Equipment (ORDEE) he Swiss Federal Council , having regard to Articles 30b , 30c , paragraph 3, letter a 30d , 30f , 30g , 30h , 39, paragraph 1 and 46 paragraph 2 of the Environmental Protection Act of 7 October 19831 (USG) and in implementation of the Basel Convention of 22 March 19892 on the control of transboundary movements of hazardous wastes and their disposal , prescribed: Section 1 - General Provisions Article 1 Purpose and scope 1 This Regulation is to ensure that electrical and electronic equipment : a. not be discharged into municipal waste ; b. environmentally compatible disposal . 2 regulates the return , redemption and disposal of electrical and electronic Geräte.1 3 The provisions of Regulation 22 June 20052 on the marketing of waste and the Chemical Risk Reduction Ordinance of 18 May 20053

#	Subject	Law	Website	Content (English)
				remain vorbehalten.4 1 Amended in accordance with Annex 3 para. II 7 of the Ordinance of 22 June 2005 on the marketing of waste, in force since 1 Jan. 2006 (SR 814.610) . 2 SR 814.610 3 SR 814.81 4 Amended in accordance with Annex 3 para. II 7 of the Ordinance of 22 June 2005 on the marketing of waste , in force since 1 Jan. 2006 (SR 814.610) . Article 2 Term 1 device as defined in this Regulation are electrically operated : a. Devices for consumer electronics ; b. Equipment of office, information and communication technology ; c. Household appliances; d. Lights; e. Lamp (without bulbs) ; f. Tools (without stationary large-scale industrial tools); g. Sports and leisure equipment and toys; 2 The provisions of this Regulation shall also apply to the electronic components of devices referred to in paragraph 1 as well as for PCB4 - containing ballasts from bulbs. 3 The Federal Office for Umwelt6 (Federal Office) may adopt a policy with a list of devices after consultation with the concerned sectors of the economy . Section 2 - Return, return and disposal Article 3 Obligation to return Who gets rid of a device, it must return a dealer, manufacturer or importer, or a disposal company. Is also permitted the return to a public collection or collection point for devices. (...) Article 5 Duty of disposal

#	Subject	Law	Website	Content (English)
				1 Deferred sales agents must dispose of the devices that they do not continue to use and not passed to other redemption subject . You can contract them. 2 Redemption shall identify what not ensure the disposal of the equipment through financial contributions to a private organization must: a. out the repossessed equipment on their own account of the disposal; b . in their outlets in a conspicuous place clearly point out that they take back equipment, and c . keep a record of the number of units sold and repossessed equipment, and keep records documenting that they have forwarded the repossessed equipment for disposal , the Federal Office and the cantons is to provide access to these documents on demand for each of the last five years. 11 Inserted by No. I of the Ordinance of 23 June 2004, in force since 1 Jan. 2005 (AS 2004 3529). Article 6 Requirements for disposal Who disposed of equipment must ensure that the disposal of environmentally friendly, in particular the state of the art is done , namely to : a. particularly polluted components such as nickel - cadmium batteries , mercury switches , PCB-containing capacitors and CFC-containing thermal insulation be disposed of separately ; b . Picture tubes and metal- containing components such as circuit boards , metal housing , metal frames , cable with high metal content and mainly consisting of metals plug devices are utilized to the extent it is economically viable ; c . non-utilized organic chemical constituents, such as plastic housing, cable insulation or resin plates are incinerated in appropriate facilities. Article 11a 1 The cantons shall enforce the regulation, where this does not transfer the execution of the federal government. 2 Apply federal agencies other federal laws or international agreements or decisions, which relate objects of this Regulation, it shall carry out the possibility that regulation. For the participation

#	Subject	Law	Website	Content (English)
				of the Federal and cantonal article is 41 paragraphs 2 and 4 USG; remain legal duties of confidentiality reserved. Section 4 - Final provisions Article 13 Entry into force This Regulation shall enter into force on 1 July 1998 in force. AS 1998 827 1 SR 814.01 2 SR 0.814.05 3 Amended by No. I of the Ordinance of 23 June 2004 , in force since 1 Jan. 2005 (AS 2004 3529) . 4 Inserted by No. . II 10 of the Ordinance of 2 Feb. 2000 to the Federal Act on the Coordination and Simplification of Decision (AS 2000 703) .
35	Electrical installations (HV)	SR 734.2 - Ordinance of 30 March 1994 (status as of 1 July 2012) on High voltage electrical power installations (HV Power Ordinance)	http://www.admin.ch/opc/de/classified-compilation/19940082/index.html#	**Table of Content for linked document. Please use link to access full text.** Applies to electrical installations having AC voltages > 1'000V, DC voltages > 1'500V. 734.2 Ordinance on high voltage electrical power installations (HV Power Ordinance) of 30 March 1994 (as of 1 July 2012) The Swiss Federal Council , having regard to Article 3 of the Federal Act of 24 June 19021 on the electric light and heavy current installations (Electricity Act) , enacted : 1st Chapter: General Provisions 2nd Chapter : Principles of safety for construction, operation and maintenance of electrical power installations 1st Section : Systems 2nd Section : accident prevention 3rd Section : measures in accidents and damage by electricity 4th Section : Control and Maintenance

#	Subject	Law	Website	Content (English)
				3rd Chapter : generation and distribution systems 1st Section : General requirements 2nd Section : indoor installations 3rd Section : Additional provisions for gas-insulated equipment 4th Section : outdoor installations 5th Section : Additional provisions for transformer stations 6th Section : Separate low-voltage systems 4th Chapter : Protective measures 1st Section : Grounding requirements 2nd Section : Overcurrent protection 3th Section : Surge Protection 5 Chapter : Working on high voltage installations 1st Section : General Provisions 2nd Section : Work on disconnected electrical power installations 3th Section : Working on energized electrical power installations 4th Section : Testing and development facilities 6th Chapter : temporary facilities 7th Chapter : Final provisions
36	Electrical installations (HV)	SR 734.2 - Ordinance of 30 March 1994 (status as of 1 July 2012) on High voltage electrical power installations (HV	http://www.admin.ch/opc/de/classified-compilation/19940082/index.html#	**Translation of relevant content. Use link to access full document.** **1 Chapter One: General Provisions** **Article 1 Scope** 1 This Ordinance regulates construction, operation and maintenance of electrical power systems. 2 The provisions for creating valid for existing installations if : a. they are a completely rebuilt ; b . they can be changed to any significant degree and meet the requirements of neither disproportionate nor is the security significantly affected ; c . they pose a danger to humans and the environment or affect

#	Subject	Law	Website	Content (English)
		Power Ordinance)		other electrical equipment disruptive to a considerable degree . 3 For low voltage installations, the specific provisions of the Ordinance of 6 remain September 19891 reserved on low voltage electrical installations. 4 If individual provisions of this Regulation are complied with only in exceptional difficulty or they prove to the technical development or the protection of the environment as a hindrance , then the Federal Department of Environment , Transport, Energy and communication2 (department) or significant in fewer cases, the competent supervisory authority (Article 21 electricity Act) upon reasoned request, authorize deviations . 5 This Regulation shall not apply to electrical installations in accordance with Article 42 paragraph 1 of the Railways Ordinance of 23 November 1983 Article 2 further instructions Unless otherwise stated, the following regulation also applies: a. Regulation of 30 March 19942 on low-voltage electrical installations (low power regulation) ; b . Regulation of 30 March 19943 via electrical lines (line regulation) ; c . the Railways Ordinance of 23 November 19835 ; d. Regulation of 9 April 19977 on Low Voltage Electrical Products (NEV); e. Regulation of 6 September 19898 on low-voltage electrical installations (NIV). Article 3 Definitions In this Regulation: 1 System grounding : Grounding a high-voltage system ; 2 Work-in : built- in switchgear , short -circuit-proof grounding device , which allows the earth only in de-energized state; 3 Shock-proof : high voltage equipment or apparatus, which are

#	Subject	Law	Website	Content (English)
				solid walls covered with electrically conductive and grounded fluid or low -voltage equipment or apparatus, which are covered with electrically conductive and grounded fluid or double insulated ; 4 Contact voltage : Part of the ground voltage of the human body between the hand and foot (horizontal distance from the contact point : 1 m); 5 Farmer : Responsible Operator (owner , lessee , tenant , etc.) of an electrical system ; 6 Operating range: Range in an electrical installation with increased risk ; 7 Reference earth : part of the ground , the outside of the sphere of influence of the earth electrode is so much that can not considerable , originating from the ground voltages occur between any two points ; 8 Ground fault: caused due to an error or an arc connecting an active investment part of the operating circuit to ground or a grounded part ; 9 Grounding: The sum of all interconnected grounding and ground lines , including metal water pipes, metal sheaths of cables, ground wires and other metal lines; 10 Grounding Conductors: The directly or indirectly from the parts to be grounded to earth electrodes carrying conductors ; 11 Gas Insulated Equipment: Gas-tight encapsulated unit. The insulation resistance of the gas as the insulating medium is determined by its pressure or its density; 12 Encapsulated installation : Electrical system whose operationally live parts are surrounded by a metal earthed protective cover ; 13 High-voltage system : Electrical system with a nominal voltage greater than 1000 V ac or 1500 V dc ;

#	Subject	Law	Website	Content (English)
				14 Interior Equipment: Electrical system inside buildings or enclosures that protect the equipment against the weather ; 15 Instructed person: person without electrical basic training , the limited , can perform clearly defined tasks in electrical power installations and is familiar with the local conditions and the appropriate protective measures ; 16 Insulation coordination: all the measures to limit over-and punctures the insulation to predetermined points of the network; 17 Short circuit: Due to an error or an arc resulting connection between the active parts of the system when a fault current circuit is not working resistance ; 18 Short circuit protection : property of a resource , the highest dynamic and thermal stresses on its installation for short-circuit withstand without impairing its ability to function ; 19 Pole Station : Transformer station on a transmission line structure ; 20 Installation Power : Space in electrical power systems , which is such that certain jobs are still possible ; 21 Low-voltage system : power plant with a rated voltage not exceeding 1000 V AC or 1500 V DC voltage; 22 Zero treatment : Excessive impedance design of the connection between the earth and the zero point of generators , transformers, and special means for forming a zero point . The most common types of connection are : resistance arms compounds (direct connections) , connections via impedances , no connections (isolated network) or combination with time following connection types ; 23 Experts person : Person in electrical engineering basic training (teaching, equivalent in-house training or study in the field of electrical engineering) and with experience in dealing with electrical equipment;

#	Subject	Law	Website	Content (English)
				24 Panel : demarcated area in which is housed a switch certain purpose , including its measurement , operation and other auxiliary equipment ; 25 Fast-acting : In switchgear built- in short -circuit and make-proof earthing device which can carry the earth on voltage without damage ; 26 Step voltage: part of the ground voltage , which you can expose with a step of 1 m; 27 Communication system : According to Article 2, paragraph 1 Electricity Act , an electric plant, which does not conduct currents normally endanger the persons or cause damage to property ; 28 Special grounding: They are so far removed from those of other grounds that they are not greatly influenced by them; 29 Power system : can endanger According to Article 2, paragraph 2 Electricity Act an electrical system for the generation, transformation , conversion , transmission , distribution and use of electricity , which is operated with currents or currents occur in foreseeable incidents , the persons or cause damage to property ; 30 Isolating distance : the necessary to ensure the necessary safety distance between the contacts and Poland open a separator; 31 TN system (zeroing) : protective measure , be attributed (PE or PEN conductor) to the feed point at which fault currents via a protective conductor ; 32 TT system (protective earthing) of protection, back flow in which fault currents through a local earth electrode and the ground at the feed point ....
37	Electrical installations (HV)	SR 734.2 - Ordinance of 30 March	http://www.admin.ch/opc/de/classified	Translation of relevant content. Use link to access full document. 2 Chapter: Principles of safety for construction, operation and maintenance of electrical power installations

#	Subject	Law	Website	Content (English)
		1994 (status as of 1 July 2012) on High voltage electrical power installatio ns (HV Power Ordinance)	-compilation/19940082/index.html#	2 Section : Accident prevention Article 9 Principle Unless this section states otherwise, the regulation of 19 December 1983 on the prevention of accidents and occupational diseases (SR 832.30) applies. Article 10 Protection against contact The holders of power systems ensure that persons who are not aware of the risks, even if carelessness, either directly or indirectly (for example, with tools, everyday devices, etc.) operatively energized parts of equipment and it connected electrical devices can approach such a way that they endanger themselves. Article 11 Requirements for professionals in electrical power systems 1 for the supervision of work on or in electrical power installations and belonging operational control equipment as well as for measures of occupational safety expert persons only may be used. 2 for the control and operation of equipment and for special work also persons must be used. 3 The freedom of movement outside parties who are active in the operating range is limited to their location and access. Article 12 instructions of persons approved in the operating range 1 The holders of power systems have for their facilities establishing a security policy and instruct Under this concept, those people who have access to the operating range, perform operational actions or work on the equipment. 2 The instruction must be repeated periodically. The time interval between two instructions is determined by the level of training of the persons concerned, the works carried out and the type of

#	Subject	Law	Website	Content (English)
				equipment. 3 The instruction is to convey particular knowledge of: a. the dangers of approaching live parts; b . Immediate measures and assistance in case of accidents; c . to boarding the plants with references to escape routes and emergency authorities ; d. that must be performed by the personnel operating procedures and work ; e. the procedure in case of fire . Article 13 Visitors 1. Power installations, which are generally temporary access must be secured so that a risk to third parties is excluded. 2. Visitors of power systems must be accompanied by knowledgeable or familiar with the equipment and authorized by the farmer people. 3. The access to the installations which are under tension is to allow only in small groups.
38	Electricity laws, Low Voltage	Standards and Norms related to the Directive 2006/95/EC ("Low Voltage")	https://extra.suva.ch/suva/b2c/b2c/start.do;jsessionid=DVDKcZas3r_goTYXBzruEKNCmWB3QwFzkRoe_SAPk-uO148-JwZfBWO9jB1snKoT;saplb_*=(J2EE505057620)505057651	**Complete listing of applicable guidelines and standards for electrical equipment (low voltage directive).** Product no. Subject title Work area / Issue date / Author CE93 - 1.d , f, i, e Listing of applicable guidelines and standards for machinery Basics 26.04.2013 Schmitter , G. CE93 - 9.d , f Isolator switch (safety switch). Guard against unexpected start-up Basics 18.05.2012 cooker , P. CE93 - 10.d , f, i, e Fees for products certification of the certification body SCESp 008

#	Subject	Law	Website	Content (English)
				Technical Department (replaced by CE08-3.d/e/f/i) Basics 04.04.2006 Schmitter , G. CE93 - 12.d , f, i, e We certify your products Basics 01.04.2010 Schmitter , G. CE93-12/1.d , f, i, e Separate sheet for certification Prospectus " We certify your products " Basics 03.01.2012 Schmitter , G. CE93-12/2.d , f, i, e Separate sheet for certification brochure " type testing of low-voltage switchgear " Basics 03.01.2012 cooker , P. CE94 - 10.d Suva , an accredited and notified certification body for products according to European law Basics 18.10.2010 Schmitter , G. CE95 - 2.d , f, i, e Checklist for type approval procedures of machines according to EC Machinery Directive 98/37/EC (Annex V / VI) (replaced by CE08-7.d/e/f/i) Basics 09.06.2005 Meyer , F. CE95 - 3.d , f, i, e Application for type certification procedures (replaced by CE08-1.d/e/f/i) Basics 01.03.2007 Schmitter , G. CE95 - 8.d , f, i, e Motion for deliberation to the CE conformity in ownership by the device manufacturer (replaced by CE08-2.d/e/f/i) Basics 01.03.2007 Schmitter , G. CE95 - 11.d Examination certificate process according to the Machinery

#	Subject	Law	Website	Content (English)
				Directive 2006/42/EC : Recovery time measurement (see also EN 693-1) Machine Tool / Industrial robots 03.05.2010 Bollier , M. CE96 - 2.d Checklist for type certification procedures for safety components according to Machinery Directive 98/37/EC (Annex V / VI) (replaced by CE08-12.d/e/f/i) Electrical and electronic structural components and controls 01.12.2005 cooker , P. CE96 - 7.d , f, i, e Directory EC Directives CE marked according to the " New Approach " Basics 26.04.2013 cooker , P. CE97 - 2.d List of CE documents for customers Basics 02.12.2013 Auchli , E. CE97 - 6.d , f, i, e Listing of applicable guidelines and standards for personal protective equipment (PPE) for equipment to protect against falls from a height Basics 26.04.2013 Bollier , M. CE97 - 7.d Checklist for examination certificate method of trapping devices for doors in accordance with the EC Machinery Directive 98/37/EC (Annex I) (replaced by CE08 - 8.d) Building- 23.01.2006 Le Grand, A. CE98 - 15.D , f, i, e Checklist for type approval procedures of personal fall protection equipment according to Directive 89/686/EEC (replaced CE98 - 14.D / e / / f / i) Basics 03.05.2010 Bollier , M. CE98 - 16.d , f, i, e Checklist of requirements for machines according to EC 98/37/EC , Annex I, Chapter 2, " Certain categories of machinery " (replaced by

#	Subject	Law	Website	Content (English)
				CE08-9.d/e/f/i) Basics 23.01.2006 Le Grand, A. CE98 - 17.d , f, i, e Checklist of requirements for machines according to EC 98/37/EC , Annex I, Chapter 3, " moving machine " (replaced by CE08-9.d/e/f/i) Basics 23.01.2006 Le Grand, A. CE98 - 18.d , f, i, e Checklist of requirements for machines according to EC 98/37/EC , Annex I, Chapter 4 " lifters " (replaced by CE08-9.d/e/f/i) Basics 18.08.2005 Kohler, W. CE98 - 19.d , f, i, e Checklist of requirements for machines according to EC 98/37/EC , Annex I, Chapter 5, " Tunnelling " (replaced by CE08-9.d/e/f/i) Basics 01.12.2005 Meyer , F. CE98 - 20.d , f, i, e Checklist of requirements for machines according to EC 98/37/EC , Annex I, Chapter 6, " lifting devices for persons" (replaced by CE08-9.d/e/f/i) Basics 18.08.2005 Kohler, W. CE98 - 23.d Checklist for type approval procedure of lifting platforms according to EEC 98/37/EC (Annex V / VI) (replaced by CE08-7.d/e/f/i) Lifts 01.05.2006 Kohler, W. CE98 - 25.D , f, i, e Checklist of requirements for personal fall protection equipment according to EC Directive 89/686/EEC Basics 03.05.2010 Bollier , M. CE00 - 2.d , f, i, e Swiss law under the European starry sky Basics 01.02.2010 Le Grand, A. CE00 - 3.d

#	Subject	Law	Website	Content (English)
				Checklist for type approval procedures for braking systems for storage and retrieval device according EGMaschinenrichtlinie 98/37/EC (Annex I) (replaced by CE08-8.d/e/f/i) Storage facilities 23.01.2006 Le Grand, A. CE00 - 4.d , f, i, e Examples of EC declarations of conformity for machinery and personal protective equipment (PPE) (replaced by CE08-17.d/e/f/i) Basics 15.11.2007 cooker , P. CE00 - 5.d Notes for EMC and Environmental testing of electrical and electronic equipment and building components (replaced CE94 - 11.d , 12.d - CE94 , CE96 - 3.d) Electrical and electronic structural components and controls 26/10/2005 Kocher , P. CE00 - 6.d , f, i, e The universe of European standards for machine safety Basics 01.02.2010 Le Grand, A. CE01 - 1.d , f, i, e Fees for products certification Express orders the certification body SCESp 008 Technical Department (replaced by CE08-4.d/e/f/i) Basics 04.04.2006 Schmitter , G. CE02 - 2.d , f, i, e Checklist of requirements for lifts (according EGMaschinenrichtlinie 98/37/EC (Annex I) (replaced by CE08-8.d/e/f/i) Lifts 01.05.2006 Kohler, W. CE03 - 2.d , f, i, e Approach to achieving the CE conformity of machines, molding machines , safety components and personal fall protection equipment (replaced by CE08-18.d/e/f/i) Basics 12.03.2007 Bollier , M. CE03 - 3.d , f, i Requirements for work baskets for Forklift (f + i languages

#	Subject	Law	Website	Content (English)
				available as download only) Maintenance 25.08.2011 Maurer , I. CE04 - 1.d , f, i, e The universe of European standards for personal protective equipment against falls Basics 01.02.2010 Bollier , M. CE04 - 2.d , f, i, e The universe of European standards for safety of electrical equipment Basics 01.02.2010 cooker , P. CE04 - 3.d , f, i, e The universe of European standards for electromagnetic compatibility Basics 01.02.2010 cooker , P. CE04 - 4.d , f, i, e European rule the universe for gates Basics 01.02.2010 Le Grand, A. CE05 - 2.d Change of used machinery Basics 30.08.2012 Bollier , M. CE06 - 1.d , f, i, e From planning to commissioning of complex systems Basics 26.05.2010 Le Grand, A. CE08 - 1.d , f, i, e Request for examination procedures / conformity assessment procedures (replaced CE95-3.d/e/f/I) Basics 06/05/2013 Schmitter , G. CE08 - 2.d , f, i, e Motion for deliberation to the CEKonformität in ownership by the device manufacturer (replaced CE95-8.d/e/f/i) Basics 06/05/2013 Schmitter , G.

#	Subject	Law	Website	Content (English)
				CE08 - 3.d , f, i, e Fees for products certification of the certification body SCESp 008 Technical Department (replaced CE93-10.d/e/f/i) Basics 03.10.2011 Schmitter , G. CE08 - 4.d , f, i, e Fees for products certification Expressauf contributions of the certification body SCESp 008 Technical Department (replaced CE01-1.d/e/f/i) Basics 03.10.2011 Schmitter , G. CE08 - 7.d , f, i, e Checklist for examination procedures of machines according to the EC Machinery Directive 2006/42/EC, Annex VII / IX (replaced CE95-2.d/e/f/i ; CE98 - 23.d ; CE00 - 3.d) Basics 06/05/2013 Bollier , M. CE08 - 8.d , f, i, e Checklist of requirements for machines according EGMaschinenrichtlinie 2006/42/EC, Annex I , gen. Principles and Chapter 1, " Basic safety and health requirements " (replaces CE98-13.d/e/f/i ; CE95-7.d/e/f/i ; CE97 - 7.d) Basics 02.11.2011 Bollier , M. CE08 - 9.d , f, i, e Checklist of requirements for machines according to the Machinery Directive 2006/42/EC , Annex I, Chapter 2-6 , " Additional basic safety and health requirements " (replaces CE98-16/CE98-7/CE98-18/CE98-19/CE98-20. d / e / f / i) Basics 02.11.2011 Bollier , M. CE08 - 12.d , f, i, e Checklist of requirements for safety components according to the Machinery Directive 2006/42/EC (Annex V / VI) (replaced CE96-2.d/e/f/i) Basics 14.02.2008 cooker , P. CE08 - 17.d , f, i, e EC declaration of conformity for machinery and declaration of incorporation for included partly completed machinery - Examples (

#	Subject	Law	Website	Content (English)
				replaced CE00-4.d/e/f/i) Basics 11/03/2013 cooker , P. CE08 - 18.d , f, i, e Approach to achieving the CE conformity of machinery, partly completed machinery and personal protective equipment against falls (replaced CE03-2.d/e/f/i) Basics 01.12.2010 Bollier , M. CE10 - 1.d , f, i, e Listing of applicable guidelines and standards for electrical equipment Basics 26.04.2013 cooker , P. CE10 - 2.d Checklist of requirements for electrical equipment according to EC Low Voltage Directive 2006/95/EC , Annex I Basics 01.03.2010 cooker , P. CE12 - 1.d , f, i, e Leaflet CE conformity of machinery - step by step Basics 01.10.2012 Durrer , A. CE12 - 2.d , f, i, e EC declaration of conformity for personal fall protection equipment (PSAgA) - Example Basics 11/03/2013 Bollier , M. CE12 - 3.d EC declaration of conformity for Niedespannungs resources - example Basics 11/03/2013 cooker , P. CE13 - 1.d , f, i, e Leaflet "Safety functions for machines - In a Nutshell " Basics 01.04.2013 cooker , P. CE13 - 2.d , f, i, e Requirements for air guns and pneumatic clutches for type tests in accordance PrSG

#	Subject	Law	Website	Content (English)
				Basics 19/08/2013 Durrer , A. CE13 - 3.d , f, i, e Checklist of requirements for air guns and compressed air couplings for type tests in accordance PrSG Basics 19/08/2013 Durrer , A. Legend: Document available in the following language : CExx - yy.d == German CExx - yy.e == English CExx - yy.f == French CExx - yy.i == Italian
39	Electricity, guidelines	Guideline (SUVA) on 10 vital rules in dealing with electricity. For professional electricians.	https://extra.suva.ch/suva/b2c/productQuickLink.do?shop=B2C_WW_de&language=de&productnr=88814%2eD	**Translation of relevant content. Use link to access full document.** 10 vital rules in dealing with electricity. For professional electricians. Legal foundations Electricity Act (Electricity Act), Article 27 Liability provisions " If one person was killed by the operation of a private or public weaknesses or high-voltage system or bodily injury, he shall be liable for the damage, if he does not prove that the accident was caused by force majeure or by negligence or oversight of third parties or by fault of the killed or injured. . " Regulation on the prevention of accidents and occupational diseases (VUV), Article 5 Personal protective equipment "Where accident and health hazards cannot be completely prevented by means of technical or organizational measures, the employer must enable reasonable personal protection. He must ensure that such personal protective measures are used as intended at all times."

#	Subject	Law	Website	Content (English)
				VUV Article 6 § 1 Information and guidance to the workers " The employer shall ensure that all employees working there including another plant , are informed of the dangers involved with their activities and instructed on the measures for their prevention in its operating employees employed . This information and instructions take place at the time the position begins. When any significant change in working conditions take place it must be repeated if necessary. " VUV Article 6, Section 3 " The employer shall ensure that workers comply with the measures of safety at work. " VUV Article 6, paragraph 4 " The information and instructions must be carried out during working hours and may not be to the detriment of the workers. " Documentation In the FCOS Directive 6508,” Directive on the involvement of occupational physicians and other specialists in occupational safety” is an occupational safety concept and in this context requires the documentation of employee training. Document the instruction, by filling out the separate sheet “instruction detection”. It contains all necessary information.
40	Elevators	SR 819.13 Ordinance of 23 June 1999 (Status as of 1 January 2013) on the Safety of	http://www.admin.ch/opc/de/classified-compilation/19994410/index.html#	**Table of Content and translation of relevant content. Use link to access full document.** SR 819.13 Ordinance on the safety of elevators (elevator Regulation) of 23 June 1999 (Status as of 1 January 2013) The Swiss Federal Council , having regard to Article 4, paragraph 1 of the Federal Act of 12 June 20091 on product safety (PrSG) implementing the Electricity Act of 24 June 19022 (Electricity Act) and the Federal Law of 6 October 19953 on Technical Barriers to

#	Subject	Law	Website	Content (English)
		elevators (Elevator Regulation)		Trade (GHG) , ordains: Section 1: General provisions Section 2: marketing of new lifts and safety components Section 3 : Reconstruction and renovation of used lifts and safety components Section 4: mandatory reporting Section 5 : Market Monitoring Section 6: ... Section 7: Final provisions Annex 1 - Basic safety and health requirements for the design and construction of lifts and safety components Annex 2 - Type examination (Module B) Annex 3 - Final acceptance Annex 4 - Quality assurance of product safety components (Module E) Annex 5 - Full quality assurance (module H) Annex 6 - Unit verification (Module G) Annex 7 - Conformity to type with random wise examination (Module C) Annex 8 - Quality assurance lifts (Module E) Annex 9 - Full quality assurance (module H) Annex 10 - Production quality assurance (module D) Annex 11 - Production quality assurance (module D) **Translation of selected passages** Section 1: General provisions Article 1 Scope 1 This Regulation shall apply to lifts permanently serving buildings and structures , as well as for the safety components referred to in Annex use in such lifts 2 It does not apply to : a lifting equipment with a speed of up to 0.15 m / s; b . Construction site hoists; c . cableways, including cable cars ;

#	Subject	Law	Website	Content (English)
				d specifically for military purposes or to maintain public order designed and constructed elevators ; e hoists, of which can be carried out from work ; f shaft hoisting systems ; g lifting appliances intended for lifting performers and performers during artistic performances ; h in transport lifting appliances fitted ; i connected to machinery and lifting equipment, the access to jobs for maintenance and inspection points are determined on machines exclusively including ; j . Rack railways; k escalators and Förderbänder. 3 For the requirements for electrical installations , the creation and control of the rules of the low-voltage installation Ordinance of 7 apply November 20012.3 2 Definitions 1 In this Regulation: a lift : a lifting appliance serving specific levels, by means of a load carrier that moves are rigid , relative to the horizontal by more than 15 ° inclined guides along and intended for carriage: 1 of persons 2 of people and goods , 3 has only of goods alone if the carrier is accessible, that is, when a person without difficulty can go into the carrier, and with controls that are placed inside the carrier or within reach of a person inside ; abis.2 load carrier : part of the lift , are housed in the passengers or goods to be lifted or lowered ; b . Assembly operation: the natural or legal person who is responsible for the design, manufacture, installation and marketing of the elevator and the declaration of conformity, c . Safety component: a component listed in Annex 11; d manufacturer of the safety components : the natural or legal person who is responsible for the design and manufacture of the safety components and the declaration of conformity, e model lift : a defined by objective parameters representative Elevator, whose technical dossier shows , as with the elevators ,

#	Subject	Law	Website	Content (English)
				which are derived from the model lift and uses identical safety components , the essential safety requirements are complied with. 2 lifting devices, but do not move along guides to rigid, in a spatially fixed course, be considered as lifts the purposes of this Regulation.
41	Environmental Impact Assessment (EIA)	BFE (National Directorate on Energy) Guidelines for the Analysis of the Environmental Impact of Wind Power Plants in Switzerland	http://www.econcept.ch/uploads/media/707_be_Umweltauswirkungen_de_def_01.pdf	**Translation of relevant content. Use link to access full document.** WIND POWER PLANTS IN SWITZERLAND - GUIDE TO THE ANALYSIS OF THE ENVIRONMENTAL IMPACT Basis for report on the environmental impact. Proposal for reporting structure. The EIA includes a preliminary investigation and, if necessary, a main study. If the preliminary investigation shows that the environmental impact of the proposed installation are not significant, i.e. that the installation meets the provisions on the protection of the environment, then the results of the preliminary investigation are sufficient for creating the environmental impact report (EIR). The main investigation is then no longer necessary (Art. 8 Section 2 UVPV). The EIR for smaller, non-problematic projects / installations can thus be limited to and based entirely on the preliminary investigation.
42	Environmental Impact Assessment (EIA)	Federal Policy for the Environmental Impact Assessment (Article 10b , paragraph 2 and Article 10 , Section 1 of USG	http://www.umwelt.sg.ch/home/recht_und_verfahren/uvp/literatur/_jcr_content/Par/downloadlist/DownloadListPar/download.ocFile/bafu_uvp_handbuch.pdf	**Translation of relevant content. Use link to access full document.** Federal Policy for the Environmental Impact Assessment (Article 10b , paragraph 2 and Article 10 , Section 1 of USG UVPV) Installations for the harnessing of wind power with an installed capacity of more than 5 MW are subject to EIA requirement in accordance with Annex No. 21.8 UVPV. "Installed capacity" refers to the power rating of the system. (Appendix No. 21.8 UVPV) The EIA is not in itself a process that leads to an autonomous decision. The EIA investigations and assessments are rather an integral component of the permitting process in the general. In other words, decisions on the project will reflect - but not be

#	Subject	Law	Website	Content (English)
		UVPV)		limited to - environmental considerations. The procedure by which binding decisions are made is referred to as the "relevant procedure”. The UVPV and cantonal laws respectively determine which the relevant procedure is. Thus, the EIA procedure ("UVPV") for projects to be decided in a cantonal procedure will often be performed as part of a "construction permitting" or "special use planning" process . (Annex UVPV and cantonal law ; Article 10a USG ; Article 5 UVPV)
43	Environmental law	SR 814.08 Protocol on Pollutant Release and Transfer Register Completed in Kiev on 21 May 2003. Swiss ratification deposited on 27 April 2007. Entered into force for Switzerland on 8 October 2009. Status as of March 6, 2012.	http://www.admin.ch/opc/de/classified-compilation/20070438/index.html	**Translation of relevant content. Use link to access full document.** Article 1 Goal The objective of this Protocol is to enhance public access to information through the establishment of coherent and integrated nationwide pollutant release and transfer registers (PRTR - Pollutant Release and Transfer Registers) in accordance with this Protocol, whereby the public participation in environmental decision-making easier and a contribution could be done to prevent and reduce environmental pollution. Article 2 Definitions For the purposes of this Protocol: 1 means "Party" means, unless from the text otherwise indicates, a government or a regional economic integration under Article 24, which has or consented to be bound by this Protocol, and for the one or the Protocol is in force; 2 means "Convention" the 25 June 1998 in Aarhus (Denmark) adopted the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters; 3 means "public" one or more natural or legal persons and, in accordance with national legislation or practice, their associations, organizations or groups; 4 means "operating" a one or more installations on the same site

#	Subject	Law	Website	Content (English)
				or on adjacent sites, which belong to the same natural or legal person or operated by it; 5 means "competent authority" means the national authority or national authorities or any other competent authority or other competent authorities to whom was given the responsibility for the operation of a National Pollutant Release and Transfer Register system of a Party; 6 means "pollutant" a substance to the environment or human health due to its properties and because it is introduced into the environment, can be harmful, or a group of such substances; 7 means "release" means any introduction of pollutants into the environment as a result of human activity, whether deliberate or accidental, regularly or not regularly, including spilling, emitting, discharging, injecting, disposing or dumping, or on the way through sewer systems without final waste water treatment; 8 means "transfer from the operation of addition," the transfer of pollutants or waste for disposal or recovery and of pollutants in waste water destined for waste-water treatment beyond the boundaries of operations,; 9 means "diffuse sources" the many smaller or scattered sources from which pollutants in soil, air or water may be released, their combined impact on those media may be significant and which are difficult in practice to obtain reports from each individual source; 10 the terms "national", "national level" and "nationwide" should be interpreted in relation to the obligations of regional economic integration organizations from this log that they apply to the region concerned, unless otherwise indicated; 11 means "waste" substances or objects which a) be disposed of or recovered, b) destined for disposal or recycling, or c) must be provided for by national legislation disposed of or recovered;

#	Subject	Law	Website	Content (English)
				12 means "hazardous waste" means waste that is defined as hazardous under its national legislation; 13 means "other waste" means waste that is not hazardous waste; 14 means "waste" water that contains substances including solids after use and regulation by national legislation subject. By mutual agreement with Germany and Austria, Switzerland used in deviation from the agreed translation throughout the word "operation" instead of "facility" (also in the composition of "company-specific"). Article 3 General provisions 1 Each Party shall take to implement this Protocol the necessary legislative, regulatory and other measures as well as appropriate measures for execution. 2 This Protocol shall limit the right of each Party to maintain in force or to set up a more extensive or more publicly accessible pollutant release and transfer registers, as this is required by this Protocol. 3 Each Party shall take the necessary measures to require that employees of an establishment and members of the public that show the authorities a violation of national law to implement this Protocol by an operation, either by the operation of the still by the authorities because of displaying punished injury, persecuted or harassed. 4 In implementing this Protocol, to be guided by the precautionary approach, as it is set forth in principle 15 of the Rio Declaration on Environment and Development of 1992, each Party. 5 In order to avoid that data are reported several times, the systems can be integrated within the granting of approvals or operating permits from pollutant release and transfer registers to the extent practicable with existing information sources such as reporting mechanisms.

#	Subject	Law	Website	Content (English)
				6 The Parties shall strive to achieve convergence between national pollutant release and transfer registers. Article 4 core elements of a system of Pollutant release and transfer registers In accordance with this Protocol, each Party shall establish a publicly accessible national Pollutant Release and Transfer Registers and maintains it; this register: a) company-specific in terms of messages to point sources; b) is capable of receiving messages to diffuse sources; c) is pollutant-specific or waste-specific; d) is a cross-media and differentiates between releases to air, soil and water; e) information about transfers; f) is based on regular compulsory declarations; g) includes standardized, timely data, a limited number of standardized reporting thresholds and looks at best limited confidentiality of the data before; h) is connected and configured so that it is user friendly and accessible to the public, including in electronic form; i) permits public participation in its development and change, and j) consists of a structured, computerized database or several linked databases maintained by the competent authority.
44	Environmental law	SR 814.20 Federal Act of 24 January 1991 on the Protection of Waters (Waters Protection Act, WPA)	http://www.admin.ch/ch/e/rs/814_20/index.html	**Table of Content for linked document. Please use link to access full text.** The Federal Assembly of the Swiss Confederation, based on Article 76 paragraphs 2 and 3 of the Federal Constitution1,2 and having considered a Federal Council Dispatch dated 29 April 19873, decrees: Title 1: General Provisions Art. 1 Purpose Art. 2 Scope of application Art. 3 Duty of care Art. 3a Polluter pays principle

#	Subject	Law	Website	Content (English)
				Art. 4 Definitions Art. 5 Exemptions for reasons of national defense or emergencies (...) Section 3: Technical Waste Water Requirements for the Granting of Building Permits Art. 17 Principle Building permits for new buildings and building alterations shall be granted only if: a. in areas served by public sewers, polluted waste water is discharged into the sewers (Art. 11 para. 1) or used for agricultural purposes (Art. 12 para. 4); b. outside areas served by public sewers, the appropriate disposal of polluted waste water is ensured through special procedures (Art. 13 para 1); the cantonal water protection agency shall be consulted to this effect; c. there is a guarantee that waste water which is unsuitable for treatment by a central waste water treatment plant may be disposed of in an appropriate manner (Art. 12 para. 2). (...) Section 4: Protection in terms of Area Planning **Art. 19 Water protection areas** 1 The cantons shall divide their territory into water protection areas according to the risks of pollution to which surface and underground waters are subject. The Federal Council shall enact the required regulations. 2 In areas which are particularly vulnerable, the construction and conversion of buildings and installations as well as operations such as excavations, earthworks and similar works may take place only provided that a cantonal permit has been granted if they may pose a risk to the waters. (...) Section 5: Handling Liquids which may pollute Water

#	Subject	Law	Website	Content (English)
				Art. 221 General Requirements 1 The persons responsible for installations for handling liquids which may pollute water must ensure that the structures and equipment required for the protection of the waters are provided regularly inspected and properly operated and maintained. Storage installations that require a permit (Art. 19 para. 2) must be inspected at least every ten years; depending on the risk of pollution to the waters, the Federal Council may stipulate inspection intervals for other installations. 2 Losses of liquid must be prevented at storage installations and shipment areas and leaks of liquid shall be easily detected and retained. 3 Installations with liquids which may pollute water may only be constructed, modified, inspected, filled, maintained, emptied and decommissioned by persons who due to their training, equipment and experience guarantee compliance with the state of the art. 4 Any person who manufactures parts for installations must test whether these parts correspond to the state of the art and document the results of the test. 5 If installations with liquids which may pollute water are constructed, modified or decommissioned, the persons responsible must report this to the canton in accordance with cantonal regulations. 6 If the person responsible for an installation with liquids which may pollute water or any person entrusted with the operation or maintenance thereof detects a leak, they shall report this immediately to the waters protection inspectorate. They shall, on their own initiative, take all reasonable measures to prevent the related pollution of waters. 7 Paragraphs 2–5 do not apply to installations that do not pose a risk of pollution to waters or only do so to a negligible extent (...)

#	Subject	Law	Website	Content (English)
				Commencement date: 1 November 1992 Final Provision of the Amendment of 20 June 1997
45	Environmental Law	Swiss Regulation (SR) - Elements of Swiss Environmental Law - Federal Acts - Ordinances - International Treaties	http://www.bafu.admin.ch/dokumentation/umweltrecht/02344/index.html?lang=en#sprungmarke3_5	Regulation in areas of specific relevance to WTG owners & operators is highlighted (bold text). Please use link to access full text. Environmental law - Environmental Protection 1. Environmental Protection Act 2. Air pollution control 3. Noise abatement Chapter 2 Vehicles, Mobile Appliances and Machines Art. 12 Inspection The enforcement authorities shall inspect the new or modified installation within one year of its being put into service to check whether the emission limitation and soundproofing measures ordered have been taken. In the event of any doubt, they carry out tests to assess the effectiveness of the measures. Chapter 7 Investigation, Assessment and Control of Exposure to Exterior Noise due to Stationary Installations3 Section 1 Investigation Art. 361Obligation to investigate 1 The enforcement authorities shall investigate the exposure to exterior noise due to stationary installations, or order its investigation if they have grounds to believe that the relevant exposure limit values are being exceeded or that this is to be expected. 2 They shall take account of increases and reductions in noise exposure levels that are to be expected due to: a. the construction, alteration or improvement of stationary

#	Subject	Law	Website	Content (English)
				installations, in particular if the projects in question have already been approved or made available for public inspection at the time of the investigation; and b. the construction, alteration or demolition of other structures if the projects have been made available for public inspection at the time of the investigation 4. Non-ionising radiation 5. Environmentally hazardous substances 813.11 Ordinance of 18 May 2005 on Protection against Dangerous Substances and Preparations (Chemicals Ordinance, ChemO) Section 1: Further Inspection Art. 100 Duties of the cantonal enforcement authorities 1 By means of random sampling, the cantonal enforcement authorities must inspect substances, preparations and objects placed on the market. 2 Within the framework of these inspections, the cantonal enforcement authorities must verify: a. that the notification, declaration and registration requirements (Articles 16, 25, 61, 67 and 68) and the provisions governing updated information (Art. 59) have been respected; b. that packaging conforms to the provisions on packaging (Articles 34a and 34e-37); c. that labelling conforms to the provisions on labelling (Articles 34b, 39-50 and Annex 1); d. that the requirements concerning the provision, updating and retention of the safety data sheet (Articles 54-56) are being complied with and that the information in the safety data sheet is not obviously incorrect; e. that the provisions on advertising (Art. 75) and samples (Art. 83) are being respected. f. that the requirement to provide information when supplying objects containing substances of very high concern (Art. 83c) has been complied with.1 6. Environmentally hazardous organisms 7. Waste / Contaminated sites / Life-cycle assessments 8. Soil protection 9. Disaster management/Major accidents

#	Subject	Law	Website	Content (English)
				814.012 Ordinance of 27 February 1991 on Protection against Major Accidents (Major Accidents Ordinance, MAO) Art. 15 Coordination of inspections of establishments As far as possible, the cantons shall coordinate the inspections of establishments which they are required to carry out under this and other legislation. Annex 3.11 (Art. 4) Establishments handling substances, preparations or special wastes The person responsible for an establishment where substances, preparations or special wastes are handled shall: a. keep records of the quantities and locations of the substances, preparations or special wastes present in the establishment which exceed the threshold quantities specified in Annex 1.1; these records are to be updated immediately in the event of significant changes and otherwise once a week; b. keep a written record of the safety-related properties of the substances or preparations specified in letter a; c. subject to special provisions, retain the records of regular inspections of safety measures for five years; d. document any significant operational failures, their causes and the measures adopted; the documents are to be retained for the duration of operations, but for a maximum of ten years; e. retain the data and documents specified in letters a-d in a safe place and, on request, provide the enforcement authority with information on the current status thereof; f. in cooperation with the emergency services, draw up an emergency plan for major accidents and carry out periodic exercises on the basis of this plan; g. inform staff of the results of the risk report. 10. Environmental impact assessment 11. Right of collective appeal in environmental matters 12. Environmental information The constituent elements of these WTG owner & operator relevant environmental laws are : 2. Air Pollution Control Ordinances

#	Subject	Law	Website	Content (English)
				Ordinance on Air Pollution Control (OAPC) Ordinance on the Incentive Tax on Volatile Organic Compounds (OVOC) Verordnung über die Lenkungsabgabe auf «Heizöl Extraleicht» mit einem Schwefelgehalt vom mehr als 0,1 Prozent (HELV) - (Ordinance on the Incentive Tax on "Extra-Light" Heating Oil with a Sulphur content of more than 0.1 per cent; ELHOO) International treaties Geneva Convention on Long-range Transboundary Air Pollution Helsinki ProTable of Content (ToC)ol to the 1979 Convention on Long-range Transboundary Air Pollution on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent Oslo ProTable of Content (ToC)ol to the 1979 Convention on Long-range Transboundary Air Pollution on Further Reduction of Sulphur Emissions Sofia ProTable of Content (ToC)ol to the 1979 Convention on Long-range Transboundary Air Pollution concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes UNECE: ProTable of Content (ToC)ol to Abate Acidification, Eutrophication and Ground-level Ozone CLRTAP Aarhus ProTable of Content (ToC)ol to the 1979 Convention on long-range Transboundary air pollution on persistent organic polluants Aarhus ProTable of Content (ToC)ol to the 1979 Convention on Long-range Transboundary Air Pollution on Heavy Metals United Nations Framework Convention on Climate Change Kyoto ProTable of Content (ToC)ol to the United Nations Framework Convention on Climate Change 3. Noise abatement Ordinance Noise Abatement Ordinance (NAO) - Noise Abatement Ordinance (NAO) 5. Environmentally hazardous substances Ordinances

#	Subject	Law	Website	Content (English)
				Chemicals Ordinance (ChemO) Chemical Risk Reduction Ordinance (ORRChem) PIC Ordinance (ChemPICO) Verordnung des UVEK über die Fachbewilligung für den Umgang mit Kältemitteln (VFB-K) - DETEC Ordinance on the Special Licence for handling Refrigerants (SLO-R) Ordinance on the Register relating to Pollutant Release and the Transfer of Waste and of Pollutants in Waste Water (PRTR-V) International treaties Vienna Convention for the Protection of the Ozone Layer Montreal Protocol on Substances that Deplete the Ozone Layer 9. Disaster management / Major accidents Ordinance Ordinance on Protection against Major Accidents (MAO) International treaty Convention on the Transboundary Effects of Industrial Accidents 10. Environmental impact assessment Ordinance Verordnung über die Umweltverträglichkeitsprüfung (UVPV) - Ordinance on the Environmental Impact Assessment (EIAO) International treaty Espoo Convention on Environmental Impact Assessment in a Transboundary Context - Espoo-Konvention 11. Right of collective appeal in environmental matters Ordinance Verordnung über die Bezeichnung der im Bereich des Umweltschutzes sowie des Natur- und Heimatschutzes beschwerdeberechtigten Organization en (VBO) - Ordinance on the Designation of Organization s with Rights of Appeal in relation to Environmental Protection and Nature and Cultural Heritage Matters (DORAO)

#	Subject	Law	Website	Content (English)
				12. Environmental information Ordinances Ordinance on the Register relating to Pollutant Release and the Transfer of Waste and of Pollutants in Waste Water (PRTR-V) International treaties Protokoll über Schadstofffreisetzungs- und -transferregister über die Beteiligung der Schweiz an der Europäischen Umweltagentur und dem Europäischen Umweltinformations- und Umweltbeobachtungsnetz (EIONET)
46	Environmental protection	SR 814.08 Protocol on Pollutant Release and Transfer Register Completed in Kiev on 21 May 2003. Swiss ratification deposited on 27 April 2007. Entered into force for Switzerland on 8 October 2009. Status as of March 6, 2012.	http://www.admin.ch/opc/de/classified-compilation/20070438/index.html	**Translation of relevant content. Use link to access full document.** Article 1 Goal The objective of this Protocol is to enhance public access to information through the establishment of coherent and integrated nationwide pollutant release and transfer registers (PRTR - Pollutant Release and Transfer Registers) in accordance with this Protocol, whereby the public participation in environmental decision-making easier and a contribution could be done to prevent and reduce environmental pollution. Article 2 Definitions For the purposes of this Protocol: 1 means "Party" means, unless from the text otherwise indicates, a government or a regional economic integration under Article 24, which has or consented to be bound by this Protocol, and for the one or the Protocol is in force; 2 means "Convention" the 25 June 1998 in Aarhus (Denmark) adopted the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters; 3 means "public" one or more natural or legal persons and, in accordance with national legislation or practice, their associations,

#	Subject	Law	Website	Content (English)
				organizations or groups; 4 means "operating" a one or more installations on the same site or on adjacent sites, which belong to the same natural or legal person or operated by it; 5 means "competent authority" means the national authority or national authorities or any other competent authority or other competent authorities to whom was given the responsibility for the operation of a National Pollutant Release and Transfer Register system of a Party; 6 means "pollutant" a substance to the environment or human health due to its properties and because it is introduced into the environment, can be harmful, or a group of such substances; 7 means "release" means any introduction of pollutants into the environment as a result of human activity, whether deliberate or accidental, regularly or not regularly, including spilling, emitting, discharging, injecting, disposing or dumping, or on the way through sewer systems without final waste water treatment; 8 means "transfer from the operation of addition," the transfer of pollutants or waste for disposal or recovery and of pollutants in waste water destined for waste-water treatment beyond the boundaries of operations,; 9 means "diffuse sources" the many smaller or scattered sources from which pollutants in soil, air or water may be released, their combined impact on those media may be significant and which are difficult in practice to obtain reports from each individual source; 10 the terms "national", "national level" and "nationwide" should be interpreted in relation to the obligations of regional economic integration organizations from this log that they apply to the region concerned, unless otherwise indicated; 11 means "waste" substances or objects which a) be disposed of or recovered, b) destined for disposal or recycling, or

#	Subject	Law	Website	Content (English)
				c) must be provided for by national legislation disposed of or recovered; 12 means "hazardous waste" means waste that is defined as hazardous under its national legislation; 13 means "other waste" means waste that is not hazardous waste; 14 means "waste" water that contains substances including solids after use and regulation by national legislation subject. By mutual agreement with Germany and Austria, Switzerland used in deviation from the agreed translation throughout the word "operation" instead of "facility" (also in the composition of "company-specific"). Article 3 General provisions 1 Each Party shall take to implement this Protocol the necessary legislative, regulatory and other measures as well as appropriate measures for execution. 2 This Protocol shall limit the right of each Party to maintain in force or to set up a more extensive or more publicly accessible pollutant release and transfer registers, as this is required by this Protocol. 3 Each Party shall take the necessary measures to require that employees of an establishment and members of the public that show the authorities a violation of national law to implement this Protocol by an operation, either by the operation of the still by the authorities because of displaying punished injury, persecuted or harassed. 4 In implementing this Protocol, to be guided by the precautionary approach, as it is set forth in principle 15 of the Rio Declaration on Environment and Development of 1992, each Party. 5 In order to avoid that data are reported several times, the systems can be integrated within the granting of approvals or operating permits from pollutant release and transfer registers to

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				the extent practicable with existing information sources such as reporting mechanisms. 6 The Parties shall strive to achieve convergence between national pollutant release and transfer registers. Article 4 core elements of a system of Pollutant release and transfer registers In accordance with this Protocol, each Party shall establish a publicly accessible national Pollutant Release and Transfer Registers and maintains it; this register: a) company-specific in terms of messages to point sources; b) is capable of receiving messages to diffuse sources; c) is pollutant-specific or waste-specific; d) is a cross-media and differentiates between releases to air, soil and water; e) information about transfers; f) is based on regular compulsory declarations; g) includes standardized, timely data, a limited number of standardized reporting thresholds and looks at best limited confidentiality of the data before; h) is connected and configured so that it is user friendly and accessible to the public, including in electronic form; i) permits public participation in its development and change, and j) consists of a structured, computerized database or several linked databases maintained by the competent authority / be.
47	Epoxy paint repairs	SR 832.314.12 Ordinance of 5 April 1966 on the Prevention of accidents and occupatio	http://www.admin.ch/opc/de/classified-compilation/19660086/196605010000/832.314.12.pdf	**Table of Content for linked document. Please use link to access full text.** 832.314.12 Ordinance on the prevention of accidents and occupational diseases when spraying paint or varnish of 5 April 1966. The Swiss Federal Council, having regard to Rule 131 of the Federal Act of 13 June 1911 on health and accident insurance, prescribed: I. Scope and definitions Article 1 - Article 2

#	Subject	Law	Website	Content (English)
		nal diseases when spraying paint or varnish		GENERAL CONDITIONS Article 3 - Article 7 III. Special provisions 1 Spray rooms, spray chapels and spray booths Article 8 - Article 21 2 Spray work on construction sites Article 22 - Article 26 3 Spray work outdoors, in large halls or of short duration Article 27 - Article 28 4 Spraying the inside of containers Article 29 - Article 37 5 Special spraying process es Article 38 - Article 42 IV Final Provisions Article 43 - Article 46 Annex I Annex II Annex III
48	Hearing protectors	Checklist (SUVA) on the Safe use and maintenance of hearing protectors	https://extra.suva.ch/suva/b2c/productQuickLink.do?shop=B2C_WW_de&language=de&productnr=67020.D	**Translation of relevant content. Use link to access full document.** Checklist for the use and maintenance of hearing protectors. Checklist for the use and maintenance of hearing protectors. Apply and your employees the ear protectors correctly? Hearing protection products offer effective protection against noise. In order to achieve the necessary protection, it needs a specific training of employees.

#	Subject	Law	Website	Content (English)
				The main risks are: ■ hearing damage because hearing protection is not worn ■ misapplication ■ lack of action due to poor maintenance With this checklist you can get a better handle on these dangers. Technical noise protection measures have priority over the use of personal hearing protection devices. Using the checklist, "Noise at Work" You can use the noise by technical means systematically destroyed (Suva-Order-Nr. 67009.d). More information on "The in-house safety inspection »(Suva order no. 66087.d).
49	Lifting platforms, safe use of	Checklist (SUVA) on the Safe use of lifting platforms	**Error! Hyperlink reference not valid.**	**Translation of relevant content. Use link to access full document.** Checklist for the safe use of lifting work platforms Will work platforms safely used in your company? Lifting platforms are a very efficient work equipment. When used correctly they provide a secure tool for working at height. But mishandling also poses risks. The main risks are: ■ fall of persons from the platform ■ tipping the platform ■ crushing people between platform and fixed facilities (e.g. buildings) ■ injuries caused by falling objects With this checklist you can get a better handle such risks.

#	Subject	Law	Website	Content (English)
50	Noise	Levels of exposure to noise (SUVA) for Workers in power generation, transmission and distribution	**Error! Hyperlink reference not valid.**	Please use link to access full text.
51	Noise pollution	Buildings Directorate of the Kanton of Zurich on Noise emissions from wind farms - Classification of windfarms as industrial plants	http://www.laerm.ch/fr/soucis-de-bruit/bruit-des-arts-et-mtiers/windturbinen/windturbinen.html	**Overview of content. Please use link to access full text.** All wind turbines are considered to produce environmental emissions. In addition to shadow, noise presents the biggest problems. All wind turbines, including small wind turbines, are considered industrial plants and must comply with the provisions of the Annex 6 of the LSV limits. For large wind turbines a complex noise survey is necessary. Small wind turbines would have to satisfy a simplified procedure. Canton of Zurich - Technical department for noise This specialized body of the Canton of Zurich provides information and a calculation tool for the assessment of noise from wind turbines (Source: www.wind-data.ch)

#	Subject	Law	Website	Content (English)
52	Noise pollution	Investigation Report No. 452'460, int 562.2432, on the Noise assessments and measures to limit emissions at Wind turbines Federal Instsitute of Materials Sciences and TechnologyDepartment for Acoustics (22 January 2010)	http://www.laerm.ch/dokumente/laermsorgen/Windturbinen_EMPA_Untersuchung.pdf	**Table of Content or linked document. Please use link to access full text.** Investigation Report No. 452'460, int 562.2432, on the Noise assessments and measures to limit emissions at Wind turbines 1 Summary 2 Initial situation and task 3 Introduction 4 Basic findings on noise emission from wind turbines 5 Basic findings on sound propagation of wind turbine noise 6 flow conditions in rough terrain 7 Requirements for a computational prediction of wind turbine noise 8 Assessment of Emissions from wind turbines 9 measures to reduce disturbance from wind turbines 10 Relevant standards 11 References
53	Noise pollution	SR 814.41 Noise Abatement Ordinance (NAO) of 15 December 1986 (Status as of 1	http://www.admin.ch/opc/en/classified-compilation/19860372/index.html	**Table of Content for linked document. Please use link to access full text.** The Swiss Federal Council, on the basis of the Federal Act of 7 October 19831 on the Protection of the Environment (the Act), ordains: Chapter 1: General Provisions Art. 12 Inspection The enforcement authorities shall inspect the new or modified installation within one year of its being put into service to check

#	Subject	Law	Website	Content (English)
		August 2010)		whether the emission limitation and soundproofing measures ordered have been taken. In the event of any doubt, they carry out tests to assess the effectiveness of the measures. Art. 35 Inspections After building works are completed, the enforcement authorities shall make random checks to verify whether the soundproofing measures comply with the requirements. In the event of any doubt, they must carry out a more detailed inspection. Chapter 2: Vehicles, Mobile Appliances and Machines Chapter 3: New and Modified Stationary Installations (incl WTGs) Chapter 4: Existing Stationary Installations (incl WTGs) (...) Chapter 7: Investigation, Assessment and Control of Exposure to Exterior Noise due to Stationary Installations (incl WTGs) 3 Section 1 Investigation Art. 361Obligation to investigate 1 The enforcement authorities shall investigate the exposure to exterior noise due to stationary installations, or order its investigation if they have grounds to believe that the relevant exposure limit values are being exceeded or that this is to be expected. 2 They shall take account of increases and reductions in noise exposure levels that are to be expected due to: a. the construction, alteration or improvement of stationary installations, in particular if the projects in question have already been approved or made available for public inspection at the time of the investigation; and b. the construction, alteration or demolition of other structures if the projects have been made available for public inspection at the time of the investigation. Chapter 8: Final Provisions (...) Annex 6 - Exposure Limit Values for Industrial and Commercial Noise

#	Subject	Law	Website	Content (English)
54	Personal Protective Equipment	Checklist (SUVA) on Personal Protective Equipment (PPA)	**Error! Hyperlink reference not valid.**	**Translation of relevant content. Please use link to access full document.** Checklist: personal protective equipment (PPE). As an employer, you are by law obliged to provide necessary personal protective equipment (PPE) to employees and to ensure that they are worn. The employees have to use PPEs wherever it is necessary. PPE includes hard hats, hairnets, goggles, shields, ear protection, respirators, protective footwear, protective gloves, protective clothing, protective equipment against falls and drowning, skin-protecting agents and, if necessary, special garments. In the context of PPE the following questions must be addressed: ■ Where and when PSA must be worn ? ■ What are the requirements which PPE must satisfy? ■ How can we ensure that the employees wear the PPE consistently at work? With this checklist you can get a better handle such problems.
55	Personal Protective Equipment	Complete list (SUVA) of Personal Protective Equipment (PPE)	http://www.suva.ch/startseite-suva/service-suva/sicherheitsprodukte-suva/persoenliche-schutzausruestung-suva.htm	**Table of Content for linked document. Please use link to access full text.** List of Personal Protective Equipment Head Protection Eye and Face Protection Hearing Protection Hand protection, arm and skin protection Foot protection Respiratory Protection Protective clothing Protection against falling and for holding and Save Protection against drowning Legal framework

#	Subject	Law	Website	Content (English)
56	Personal Protective Equipment	Federal Office for Economy, Education and Research (WEKO) of November 2011 on Guidelines to Regulations 3 and 4 of the Swiss Labor Code	http://www.seco.admin.ch/dokumentation/publikation/00009/00027/01625/index.html?lang=de&download=NHzLpZig7t,lnp6I0NTU042l2Z6ln1acy4Zn4Z2qZpnO2Yuq2Z6gpJCEdXt4gGym162dpYbUzd,Gpd6emK2Oz9aGodetmqaN19XI2IdvoaCVZ,s-	**Translation of relevant content. Please use link to access full document.** Guidelines to Regulations 3 and 4 of the Labor Code Using practical examples, this Guideline explains the provisions of Regulations 3 (health care) and 4 (Industrial plants, plan approval and operating permit) to the labor law. It serves law enforcement agencies as directly affected entrepreneurs, architects, planners and other professionals.
57	Personal Protective Equipment	Guidelines for businesses (SUVA) on Personal Protective Equipment (PPE)	https://extra.suva.ch/suva/b2c/download/(cpgnum=1&layout=7.01-15_1_71_126_6_123&cquery=&cadvsearch=false&uiarea=1&carea	**Overview of content. Please use link to access full text. This document provides inspection (prüfung) requirements for PPE.** Everything you need to know about personal protective equipment (PPE). Documentation for operators relating to personal protective equipment (PPE). Before be introduced in a PSA operation, there are always the same questions: • Are PSA actually the right way to protect its employees against the hazards that exist? • What are the correct PPE?

#	Subject	Law	Website	Content (English)
			=4C75A69C442C40A0E10080000A63035B&citem=4C75A69C442C40A0E10080000A63035B4F39174410B412A0E10080000A630387)/.do;jsessionid=Rmcn3zzgvf6CeRB9ZfPLQsSjQY-0QwFWdT4e_SAP7RHse7tmU6qHf6QWKjbuqGnl;saplb_*=(J2EE507409720)507409750?doctype=pdf&docid=0000000000037223&file=44091_D.pdf	• Where and when PPE must be worn ? • How to improve the supporting discipline? Answers to such questions can be found in this brochure. It is aimed at managers, purchasers of PPE and safety representatives. Table of Contents / Page 1 PSA - a topic that (almost) all relates to 4 2 Legal Framework 5 3 Where and when PSA must be used? 7 4 What must be observed when procuring PPE? 9 5 introduction of the PSA and enforcing a support Obligatoriums 11 6 Care and maintenance of PSA 14 7 Head Protection 15 8 Eye protection 17 9 Hearing protection 21 10 Hand Protection, Arm 24 11 Skin Protection 29 12 Foot Protection 30 13 Respiratory Protection 34 14 Protective clothing 37 15 Protection against falling 44 16 Protection against drowning 50 17 Additional information 53
58	Rope Fastening	Guidelines (SUVA) on Working with rope	**Error! Hyperlink reference not valid.**	**Translation of relevant content. Please use link to access full document.** Eight vital rules for working with rope fastening.

#	Subject	Law	Website	Content (English)
		fastening		Rule 1: Collective protection take precedence. Rule 2: Provide training. Rule 3: Check the Equipment. Rule 4: Work carefully, prepare. Rule 5: Secure attachment points use. Rule 6: Adjust equipment individually Rule 7: Use fall protection ladders safely. Rule 8: Ensure rescue. Check, document, indicate: • After mounting the fixing means (screws, check plugs) according to the manufacturer. • The installation of permanent anchor points or systems must be clearly documented (according to manufacturer). • Attachment points must permanently are identified.
59	Working at Heights	SR 832 311 141 Federal Regulation of 29 June 2005 (as of November 1, 2011) on the Safety and health of workers in construction work (Construction Regulation , BauAV)	http://www.admin.ch/opc/de/classified-compilation/20051459/index.html#	**Translation of relevant content. Use link to access full document.** Requirements on working at heights are described in chapter 9, working on ropes, article 82 of 832 311 141 Federal Regulation of 29 June 2005 (as of November 1, 2011) on the safety and health of workers in construction work (Construction Regulation , BauAV) The Swiss Federal Council , having regard to Article 83 , paragraph 1 of the Accident Insurance Act of 20 March 19811 (LAA) and Article 40 of the Labor Code of 13 March 19642 (ArG) decrees: 1 Chapter One: General Provisions 2 Section : Specifications for all construction work 3 Chapter : Working on roofs 4 Chapter : Scaffolding 5 Chapter : Trenches , shafts and pits 6 Chapter : Dismantling or demolition work 7 Chapter : Untertagarbeiten 8 Chapter Degradation of rock , gravel and sand 8a. Chapter: Heat engineering installations and high chimneys **9 Chapter: Working on the hanging rope (for rope access**

#	Subject	Law	Website	Content (English)
				inspections on WTG rotor blades) Article 82 1 For work on the hanging rope only workers may be used that have appropriate training. 2 At least two workers are used so that they can monitor each other. 3 The cable system must be separated from each other by at least two have anchored ropes , one as a means of access, descent and support (work rope) and the other as backup (security rope) . 4 The use of a single rope may be permitted if in accordance with the risk assessment, the use of a second rope would increase a risk of workers in the work. It must be taken other appropriate measures to ensure the safety and health of workers. 10 Chapter: Working in pipelines 10a. Chapter : Legal 11 Chapter : Final provisions
60	WTG Relevant International Standards (IEC)	IEC Standards for Wind Turbines (EN 61400 series)	http://www.iec.ch/cgi-bin/getfile.pl/sbp_88.pdf?dir=sbp&format=pdf&type=&file=88.pdf	**Overview of content. Please use link to access full text.** Switzerland follows the standards published by IEC Technical Committees and Subcommittees TC 88 (Wind Turbines). First formed in 1987 the scope for TC 88 was last formulated in 2002 as: “To prepare international standards for wind turbines that convert wind energy into electrical energy. These standards address design requirements, engineering integrity, measurement techniques and test procedures. Their purpose is to provide a basis for design, quality assurance and certification. The standards are concerned with all subsystems of wind turbines, such as mechanical and internal electrical systems, support structures and control and protection systems. They are intended to be used together with appropriate IEC/ISO standards”. By August 2011 the following TC 88 publications have been issued: IEC 61400-1, Edition 3.0, 2005-08-31, Wind turbines - Part 1: Design requirements IEC 61400-1-am1, Edition 3.0, 2010-10-13, Amendment 1 - Wind

#	Subject	Law	Website	Content (English)
				turbines - Part 1: Design requirements IEC 61400-2, Edition 2.0, 2006-03-21, Wind turbines - Part 2: Design requirements for small wind turbines IEC 61400-3, Edition 1.0, 2009-02-11, Wind turbines - Part 3: Design requirements for offshore wind turbines IEC 61400-11, Edition 2.1, 2006-11-28, Wind turbine generator systems - Part 11: Acoustic noise measurement techniques IEC 61400-12-1, Edition 1.0, 2005-12-16, Wind turbines - Part 12-1: Power performance measurements of electricity producing wind turbines IEC/TS 61400-13, Edition 1.0, 2001-06-28, Wind turbine generator systems - Part 13: Measurement of mechanical loads IEC/TS 61400-14, Edition 1.0, 2005-03-22, Wind turbines - Part 14: Declaration of apparent sound power level and tonality values IEC 61400-21, Edition 2.0, 2008-08-13, Wind turbines - Part 21: Measurement and assessment of power quality characteristics of grid connected wind turbines IEC 61400-22, Edition 1.0, 2010-05-31, Wind turbines - Part 22: Conformity testing and certification IEC/TS 61400-23, Edition 1.0, 2001-04-26, Wind turbine generator systems - Part 23: Full-scale structural testing of rotor blades IEC 61400-24, Edition 1.0, 2010-06-16, Wind turbines - Part 24: Lightning protection IEC 61400-25-1, Edition 1.0, 2006-12-14, Wind turbines - Part 25-1: Communications for monitoring and control of wind power plants - Overall description of principles and models IEC 61400-25-2, Edition 1.0, 2006-12-14, Wind turbines - Part 25-2: Communications for monitoring and control of wind power plants - Information models IEC 61400-25-3, Edition 1.0, 2006-12-14, Wind turbines - Part 25-3: Communications for monitoring and control of wind power plants - Information exchange models IEC 61400-25-4, Edition 1.0, 2008-08-28, Wind turbines - Part 25-4: Communications for monitoring and control of wind power plants - Mapping to communication profile IEC 61400-25-5, Edition 1.0, 2006-12-14, Wind turbines - Part 25-5: Communications for monitoring and control of wind power plants - Conformance testing IEC 61400-25-6, Edition 1.0, 2010-11-29, Wind turbines - Part 25-6: Communications for monitoring and control of wind power plants -

#	Subject	Law	Website	Content (English)
				Logical node classes and data classes for condition monitoring ISO 81400-4, Edition 1.0, 2006-04-20, Wind turbines - Part 4: Design and specification of gearboxes ISO 81400-4, Edition 1.0, 2006-09-20, Corrigendum 1 - Wind turbines - Part 4: Design and specification of gearboxes **Participating countries** are: Austria, Canada, China, Denmark, Finland, **France,** Germany, Greece, India, Ireland, Israel, **Italy,** Japan, the Republic of Korea, the Netherlands, Norway, Portugal, the Russian Federation, South Africa, Spain, Sweden, **Switzerland,** the United Kingdom and the United States (24 countries). Observing countries are: Australia, Belgium, Brazil, **Bulgaria,** the Czech Republic, Egypt, New Zealand, Poland, Romania, Serbia, Slovenia, and the Ukraine(12 countries). Liaisons exist with the, IEC/TC 8, IEC/TC 21, IEC TC 57, IEC TC 82, IEC/TC 114, ISO/TC 43, ISO/TC 60 (ISO/TC 60and IEC TC 88 have a JWG on Design requirements for gearboxes for wind turbines), ISO/TC 98, the International Energy Agency, and the Organization for Economic Co-Operation and Development.

Appendix G.

Italian Regulations

#	Subject	Law	Link	Content (English)
1	Confined space regulations	D.lgs. 9 Aprile 2008, n. 81 - Testo Unico sulla salute e sicurezza sul lavoro Circular no. 42 of 2010 09/12/2010 Health and safety in the workplace Work in areas suspected of contamination. Initiatives relating to contracts for cleaning and maintenance activities which expose workers to the risk of suffocation or poisoning due to emission of toxic or harmful	http://www.lavoro.gov.it/SicurezzaLavoro/Documents/TU%2081-08%20-%20Ed.%20Ottobre%202013.pdf	DECREE OF THE PRESIDENT OF THE REPUBLIC September 14, 2011, n . 177 Regulations for the qualification of companies and self-employed workers operating in areas suspected of contamination or neighbors, in accordance with Article 6, paragraph 8, letter g) of the legislative decree 9 April 2008, no . 81. Articles 1 - Purpose and Scope 2 - Qualification in the area of suspected pollution or confined environments 3 - Safety Procedures in the area of suspected pollution or confined environments 4 - Clause invariance financial Circular no. 42 of 2010 09/12/2010 Subject: Health and safety in the workplace ; work in areas suspected of contamination. Initiatives relating to contracts for cleaning and maintenance activities which expose workers to the risk of suffocation or poisoning due to emission of toxic or harmful substances Circular no. 13 of 2011 of 19/04/2011 Subject: Health and Safety in the workplace; work in areas suspected of contamination. Initiatives relating to contracts for cleaning and maintenance activities which expose workers to the risk of suffocation or poisoning caused by fumes toxic or harmful substances Note the 32/0010248/MA001.A001 Port 09/05/2012 Subject: illustrated manual for work in environments suspected pollution or confined pursuant to art. Paragraph 3 of 3 Presidential Decree 177/2011. TABLE OF CONTENTS INTRODUCTION 1. KEY POINTS FOR THE DEVELOPMENT OF SAFETY PROCEDURES 1.1 Measurements and preliminary precautions 1.2 Signage 1.3 Implementation of the 1.4 Information, education, training and health fitness for the specific task

#	Subject	Law	Link	Content (English)
		substances		2. ILLUSTRATED HISTORY 2.1 Qualification of the company 2.2 Risk analysis and operational procedure 2.3 Identification of the representative of the Employer and Client information workers of the subcontractor 2.4 Risks from hazardous substances or oxygen deficiency 2.5 Personal Protective Equipment 2.6 Risk of fire and explosion 2.7 Emergency procedures and rescue ANNEX 1 -a - AUTHORIZATION FORM FOR ENTRY IN CONFINED SPACES IN THE EVENT OF EXPECTATION OF WORK TO CONTRACTORS OR SELF-EMPLOYED ANNEX 1 -b - AUTHORIZATION FORM FOR ENTRY IN CONFINED SPACES ANNEX 2 - ILLUSTRATIVE LIST OF POSSIBLE RISK FACTORS IN CONFINED SPACES ANNEX 3 - TECHNICAL ASPECTS TO KNOW / ASSESS THE START OF WORK ANNEX 4 - EXAMPLE OF A CHECKLIST ANNEX 5 - MAJOR LEGISLATIVE REFERENCES RELATING TO CONFINED SPACES OR SUSPECTED OF POLLUTION ANNEX 6 - TOXIC SUBSTANCES AND TYPE AND ACCIDENTS asphyxiating ANNEX 7 - Signage that you may want to put in confined spaces or suspected pollution

#	Subject	Law	Link	Content (English)
2	Electrical safety regulations	TESTO UNICO TITLE III - USE OF WORK EQUIPMENT AND PERSONAL PROTECTIVE EQUIPMENT CHAPTER III - PLANT AND ELECTRICAL EQUIPMENT	http://www.lavoro.gov.it/SicurezzaLavoro/Documents/TU%2081-08%20-%20Ed.%20Ottobre%202013.pdf	CHAPTER III - PLANT AND ELECTRICAL EQUIPMENT Article 80 - Obligations of the employer 1. The employer shall take the necessary measures to ensure that workers are protected from all electrical hazards associated with the use of materials, equipment and electrical equipment made available to them and , in particular, those arising from: a) direct electrical contact ; b) indirect electrical contacts ; c) initiation and propagation of fires and burns due to dangerous overheating , arcing and radiation ; d) initiation of explosions ; e) Direct and indirect lightning strikes ; f) Surge ; g) any other reasonably foreseeable fault conditions . 2. To this end, the employer shall conduct an assessment of the risks referred to in paragraph 1, taking into consideration: a) the conditions and the specific characteristics of the job, including any interference ; b) the risks present in the workplace; c) all foreseeable operating conditions . 3. Following the assessment of electrical hazards, the employer shall take technical and organizational necessary to eliminate or minimize the risks present, to identify protective and collective Individual needed for the safe conduct of work and to develop procedures for use and maintenance over time to ensure the permanence of the level of safety attained by the adoption of the measures referred to in paragraph 1. 3-bis. The employer shall, also , the measures necessary to ensure that the operation and maintenance procedures referred to in paragraph 3 shall be prepared and implemented taking into account the laws of, the indications contained in the user manuals and maintenance of equipment falling in the specific directives of the product and then those specified in the relevant standards tecniche.59

#	Subject	Law	Link	Content (English)
3	Environmental Impact of wind farms on birds	European analysis and guidance document	http://www.anev.org/wp-content/uploads/2012/05/Concil-of-Europe_windfarms-and-birds_2003.pdf	COUNCIL OF EUROPE: WINDFARMS AND BIRDS: AN ANALYSIS OF THE EFFECTS OF WIND FARMS ON BIRDS, AND GUIDANCE ON ENVIRONMENTAL ASSESSMENT CRITERIA AND SITE SELECTION ISSUES This report was commissioned by the Council of Europe for the Bern Convention as an update of the one commissioned by them last year and presented to the 22nd meeting of the Standing Committee for information. Its remit is to 'analyze the impact of wind farms on birds, establishing criteria for their environmental impact assessment and developing guidelines on precautions to be taken when selecting sites for wind farms'. This revised version has, as an additional annex (Annex 2), a draft recommendation for consideration by the 23rd meeting of the Standing Committee.
4	Fire prevention	Presidential Decree August 1, 2011 , no. 151 NEW RULES OF FIRE PREVENTION Full text	http://www.funzionepubblica.gov.it/media/865744/dpr151-2011.pdf	**Full translation of main body of text of document referred to.** Presidential Decree August 1, 2011, no. 151 Regulations on procedures relating to fire prevention, in accordance with Article 49 -quarter, paragraph 4 , Decree - Law of 31 May 2010, no. 78 , with converted with amendments by Law of 30 July 2010, no. 122. (OJ No . 221 2292011) THE PRESIDENT OF THE REPUBLIC ISSUES The following regulations Article 1. Definitions 1. For the purposes of this Regulation shall apply: a) ' control ' means the provincial command of the fire territorial jurisdiction ; b) " Directorate " means the Directorate- regional or inter-regional fire brigade rescue the public and civil defense ; c) ' CTR ': the Regional Technical Committee for the prevention of fires in Article 22 of Legislative Decree of 8 March 2006 n . 139. d) ' SKI ' signaling certified logon , pursuant to Article 19 of the Law

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				of 7 August 1990, n. 241 , as amended by Article 49 , paragraph 4-bis of the Decree - Law of 31 May 2010, no. 78 , converted, with amendments, by Law of 30 July 2010, no. 122 , in which the receipt of the report is proof of authorization in accordance with Article 38 , paragraph 3, e) and f) of Decree - Law of 25 June 2008, no. 112 , converted to , with amendments, by Law of 6 August 2008 n . 133; e) ' OSS ': the one-stop shop for productive activities , which is the single point of access for the applicant in relation to all administrative matters relating to its manufacturing activity and provides a unique and timely response in lieu of all that public administrations , however, be involved in the proceedings; f) ' CPI' : Fire Prevention Certificate in accordance with Article 16 , paragraph 1, of Legislative Decree, March 8, 2006. 139. Section 2. Aims and scope 1. This regulation identifies activities subject to fire prevention inspections and discipline , for the filing of the projects, for the consideration of projects, technical visits , for approval of exceptions to specific regulations , the verification of the conditions of fire safety that, under current law , are attributed to the competence of the National Body of firefighters . 2. Within the scope of this Regulation covers all activities subject to fire prevention inspections set out in Appendix I to this regulation. 3. Activities subject to fire prevention inspections are divided into categories A, B and C, as identified in Annex I in relation to the size, sector class of business, the existence of specific technical rules, the need to protect public safety. 4. The list of activities subject to health checks referred to in Annex I to this Regulation shall be subject to review, in relation to the changing needs of safeguarding the conditions of fire safety. 5. The revision of the list of activities subject to fire prevention inspections, listed in Annex I shall be established by decree of the President of the Republic, to be issued in accordance with Article 17, paragraph 1, of the Law of 23 August 1988, no . 400, on the proposal of the Minister of the Interior, after consultation with the

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				Central Committee for Scientific and Technical fire prevention. 6. Are excluded from the scope of this Regulation industrial activities at risk of a major accident , subject to the submission of the safety report referred to in Article 8 of Legislative Decree of 17 August 1999 no. 334 , as amended. 7. In order to ensure uniformity of procedures and transparency and rapidity of administration, the manner of presentation of the instances covered by this Regulation and the relevant documents to be annexed, shall be governed by decree of the Minister of the Interior. 8. By the Decree of the Minister of the Interior in consultation with the Minister of Economy and Finance provided for in Article 23, paragraph 2 of Legislative Decree n March 8, 2006. 139 are set fees for services performed by the National Fire Prevention Fire Department. Section 3. Evaluation of projects 1. The institutions and individuals responsible for the activities listed in Annex I group B and C , are required to apply with special application to control the examination of projects for new installations or construction and draft amendments to existing ones, which constitute pre-existing conditions of fire safety. 2. The projects referred to in paragraph 1 shall be accompanied by the documentation required by the decree referred to in paragraph 7 of Article 2 of this Regulation. 3. Command examine the proposals and within thirty days may request documentation Accounts. The Command to pronounce on the conformity of the legislation and the technical criteria for fire prevention within sixty days from the date of submission of complete documentation. Section 4. Fire prevention inspections 1. For activities listed in Annex I to this Regulation, the application

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				referred to in paragraph 2 of Article 16 of Legislative Decree n March 8, 2006. 139, shall be submitted to the Command, before the exercise of the activity, signaling through certified logon, accompanied by the documentation required by the decree referred to in Article 2, paragraph 7 of this Regulation. The command verifies the formal completeness of the application, documentation and related Annexes and, if successful, will issue a receipt. 2. For activities listed in Annex I, Group A and B, the control, within sixty days after the instance referred to in paragraph 1 shall carry out checks, through technical visits, in order to ascertain compliance with the requirements laid down by fire prevention regulations, as well as the existence of the fire safety requirements. The controls are arranged with sampling basis or on the basis of sectorial programs, by type of business or in situations of potential danger, however, have been reported or detected. Within the same timeframe, in case of ascertained - nanny shortage of requirements and conditions for the exercise of the activities required to comply with fire prevention, the control measures shall motivated ban on the continuation of the activity and removal of any harmful effects from same products , with the exception that, where possible , the person concerned them take care to conform to fire regulations and the criteria of technical fire prevention that activity within a period of forty-five days. 3. For activities listed in Annex I Category C, Command, within sixty days of receipt of the instance referred to in paragraph 1 shall carry out checks, through technical visits, aimed at compliance with the requirements provided by law fire prevention, not because of the legal requirements of fire safety. Within the same timeframe, in case of lack of requirements and conditions for the exercise of the activities required to comply with fire prevention, the control measures shall motivated ban on the continuation of the activity and removal of any harmful effects from same products, with the exception that, where possible, the person concerned them take care to conform to fire regulations and technical criteria for fire prevention that activity within a period of forty-five days. By then we - days from the date of execution of technical inspections carried out on the activities referred to in this paragraph, if

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				successful, the command issuing the certificate of fire prevention. 4. The command acquires the certificates and declarations of conformity of the activities listed in Annex I to the fire prevention regulations, pursuant to paragraph 4 of Article 16 of Legislative Decree March 8, 2006. 139 5. If the inspection is to be carried out by the Command during a consent procedure which involves a deliberate act preparatory issued by corporate bodies, which is called to be part of the same command, apply different limits set for these proceedings. 6. Notwithstanding the provisions of Article 3 of this Decree in the event of changes that involve an increase of the existing conditions of fire safety , the requirement for that person to start again with the procedures provided for in this article occurs when there are changes in processing or structures , in the case of the new destination of the premises or of qualitative and quantitative variations of hazardous substances existing in factories or warehouses and whenever a change will overtake the safety conditions previously established. Section 5. Attestation of conformity periodic renewal of Fire 1. The request for Fire periodic renewal of conformity that every five years , the holder of the activities listed in Annex I to this Regulation shall be obliged to send the command is carried out through a declaration certifying that no changes to the safety condi - Fire za accompanied by the documentation required by the decree of art. 2 , paragraph 7 of this Regulation. Command releases contextual receipt of submission of the declaration. 2. For activities under numbers 6, 7, 8, 64 , 71, 72 and 77 of Annex I, every five years referred to in paragraph 1 is elevated to ten years. Section 6. Obligations associated with the exercise of 1. The institutions and individuals responsible for activities listed in Annex 1 of this Regulation and is not subject to the regulations of

#	Subject	Law	Link	Content (English)
				the legislative decree 9 April 2008, no . 81 , as amended, have an obligation to maintain in a state of efficiency systems , devices, equipment and the three fire safety measures taken and to carry out monitoring and maintenance in accordance with the time periods that are indicated Command in the prevention certificate or the time of issue of the receipt following the submission of the SCIA referred to in Article 4 , paragraph 1 of this regulation, and to ensure adequate information about the risks of fire associated with the specific activity on the measures of prevention and protection adopted on precautions to prevent the occurrence of a fire and the procedures to be followed in case of fire. 2. The checks, inspections, maintenance and the information referred to in paragraph 1 shall be recorded in a special register in the care of responsible activity. This register must be kept up to date and made available for the purpose of controls pertaining to the Co- control. Section 7. Exemptions 1. If the assets subject to fire prevention inspections referred to in Annex I to the present Regulation yourself, have characteristics that do not permit full compliance with the technical rules of fire prevention regulations, interested parties, in the manner established by Decree referred to in Article 2, paragraph 7 of this Regulation, submit to the command request for an exemption to comply with fire regulations. 2. May submit an application for exemption, in the manner referred to in paragraph 1, including the holders of activities governed by specific rules of fire prevention techniques, which are not among those listed in Annex 1. 3. The command examines the application and, with its reasoned opinion, the transmit within thirty days to the Regional Directorate - in . The Director, after consultation with the Regional Technical Committee for the prevention of fires, referred to in Article 22 of Legislative Decree n March 8, 2006. 139 , a decision within sixty days of the receipt of the application , and shall simultaneously send the command to which the same has been made and the

#	Subject	Law	Link	Content (English)
				applicant. Article 8. Nothing precludes the feasibility 1. The institutions and individuals responsible for the activities listed in Annex I to this Regulation, categories B and C , may apply to the Command of the preliminary examination of the feasibility of the projects of particular complexity , for the purposes of granting the authorizations feasibility . Section 9. Checks work in progress 1. The institutions and individuals responsible for the activities listed in Annex I to this Regulation, may apply to the Command carrying out technical inspections to be carried out in the course of realization of the work. Article 10. Reconciliation with the procedures of the one-stop shop for productive activities (OSS) 1. For activities listed in Annex I to this Regulation pertaining to the OSS shall apply approx. decree of the President of the Republic 7 September 2010, n . 160. 2. For the sole purpose fire-fighting activities listed in Annex I, Group A , fall under the procedure referred to in Chapter III of the Decree of the President of the Republic 7 September 2010, n . 160 , except in cases covered by the ordinary procedure referred to in Chapter IV of the decree . 3. The documentation referred to in point a) paragraph 1 of Article 10 of the Decree of the President of the Republic - 7 September 2010, n. 160 is completed, the work for the purposes of compliance with the requirements laid down by the rules of fire prevention, the SCIA referred to in Article 4 of this Regulation. Article 11. Transitional and Final Provisions 1. Until the adoption of the Ministerial Decree referred to in paragraph 7 of Article 2 of this Regulation , the provisions of the

#	Subject	Law	Link	Content (English)
				Decree of the Minister of the Interior May 4, 1998 of fire prevention procedures , as well as the uniformity the related services rendered by provincial fire brigade . " 2. Until the adoption of the Ministerial Decree referred to in paragraph 7 of Article 2 of this Regulation , the application described in paragraph 1 of Article 4 , submitted to the commissioning of the deposits of liquefied petroleum gas tanks fixed total capacity not exceeding 5 cubic meters not in service activities listed in Annex I, are attached : a) the declaration of conformity referred to in Article 7 of the Decree of the Minister of Economic Development of 22 January 2008, no. 37; b) a statement certifying that the holder shall conform to the requirements in force in the field of fire prevention and is committed to compliance with the obligations laid down in Article 6 of this Regulation ; c) a floor plan of the deposit, in appropriate scale signed by a professional registered in the relevant register and context specific skills or technical manager of the company by the installation of the deposit. 3. Until the adoption of the Ministerial Decree referred to in paragraph 2 of article 23 of legislative decree n March 8, 2006. 139 , the provisions of the Decree of the Minister of Interior 3 February 2006 adopted in consultation with the Minister of Economy and Finance. For new activities introduced in Annex I to this Regulation, the rates already provided for the activities of similar complexity, as identified in the table of equivalence set out in Annex II to this Regulation. 4. The institutions and individuals responsible for the new activities introduced in Annex I, existing at the date of publication of this Regulation, must carry out the prescribed requirements within one year from the date of entry into force of this Regulation. 5. The institutions and individuals responsible for the activities listed in Annex I, existing at the date of entry into force of this Regulation and in possession of the Certificate of fire prevention, the expiration of the certificate must fulfill the obligations

#	Subject	Law	Link	Content (English)
				prescribed in Article 5 of this Regulation. 6. The institutions and individuals responsible for the activities referred to in paragraph 2, Article 5 , present the first evidence of periodic renewal , by the following deadlines : a) within six years from the date of entry into force of this Regulation for activities with certificate of one-off fire prevention issued prior to 1 January 1988; b) within eight years from the date of entry into force of this Regulation, for operations with one-off fire prevention certificate issued in the period between 1 January 1988 and 31 December 1999; c) within ten years from the date of entry into force of this Regulation, for operations with one-off fire prevention certificate issued in the period between 1 January 2000 and the date of entry into force of this Regulation. 7. The institutions and individuals responsible for the activities listed in Annex I, which at the date of entry into force of this Regulation shall have received the opinion of conformity referred to in Article 2 of the Decree of the President of the Republic on 12 January 1998, n . 37 shall carry out the fulfillment referred to in Article 4 of this Regulation. 8. Are subject to the provisions of Article 16, paragraph 7 of the legislative decree n March 8, 2006. 139. Article 12. Repeals 1. From the date of entry into force of this Regulation, the following provisions are repealed : a) Decree of the President of the Republic on 26 May 1959. 689 Regulation on the “determination of the subject companies and work, for the prevention of in - fires, the control of the Corps Command of the fire”; b) Decree of the President of the Republic 12 January 1998, n . 37 Regulation laying down “rules on procedures relating to fire prevention, in accordance with Article 20, paragraph 8, of the Law of 15 March 1997, n . 59 " ; c) Decree of the President of the Republic of 12 April 2006, n. 214 "

#	Subject	Law	Link	Content (English)
				Regulation on the simplification of procedures for fire prevention concerning deposit and LPG in fixed reservoirs with a total capacity not exceeding 5 cubic meters " ; d) Decree of the Minister of 16 February 1982 laying down amendments to the Decree of the Minister of the Interior September 27, 1965 , concerning the determination of activities subject to fire prevention inspections ; e) Article 16 of Legislative Decree n March 8, 2006. 139 , entitled " Reorganization of the provisions relating to the functions and duties of the National Fire Department , in accordance with Article 11 of the Law of 29 July 2003 no. 229 " limited to: 1) paragraph 1: the second period ; 2) paragraph 2: the words " at the conclusion of a proceeding " to the words " same activities " ; 3) paragraph 4: the words "For the purposes " to the words " fire prevention " and the words " in addition to performing " up to the words " the findings and assessments " ; f) Article 6 , paragraph 8 of the Decree of the President of the Republic on 6 June 2001 n . 380. Article 13. Provision of financial neutrality 1. The implementation of this Regulation should not result in new or increased charges dear co - finance the public. 2. The interested public administrations carry out the activities provided for in this Regulation with the human resources, equipment and financial resources to current legislation.
5	Forklift, and cherry picker maintenance requirements	Guidelines for the Maintenance of Forklifts	http://www.ispesl.it/sitodts/Linee_guida/Linee%20Guida%20Controllo%20Periodico%20Carrelli.pdf	ISPESL-DTS Guidelines for the Maintenance of Forklifts

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6	Guidelines on use of helicopters for access to sites.	Guidelines "helicopters" - Guidelines on the assessment of risks in temporary and mobile sites requiring the use of helicopters.	http://www.ispesl.it/sitodts/Linee_guida/elicotteri.pdf	
7	HSE training (common principles, obligations, sanctions)	D.lgs. 9 Aprile 2008, n. 81 - Testo Unico sulla salute e sicurezza sul lavoro	http://www.lavoro.gov.it/SicurezzaLavoro/Documents/TU%2081-08%20-%20Ed.%20Ottobre%202013.pdf	Leg. April 9, 2008, n . 81 CONSOLIDATED HEALTH AND SAFETY AT WORK Implementation of Article 1 of the Law 3 August 2007, n . 123 concerning the protection health and safety in the workplace. (Official Gazette no. 101 of 30 April 2008 - Suppl . Ordinary n . 108) (Decree supplementary and corrective : Official Gazette no. 180 of 05 August 2009 - Suppl . Ordinary n . 142 / L) TITLE I - COMMON PRINCIPLES CHAPTER III - THE PREVENTION MANAGEMENT IN THE WORKPLACE SECTION IV - EDUCATION , INFORMATION AND TRAINING Article 36 - Information to workers 1. The employer shall ensure that each worker receives adequate information: a) the risks to health and safety at work related to the activities of the enterprise in general; b) Procedures regarding first aid , firefighting , evacuation of the workplace; c) the names of the workers required to implement the measures referred to in Articles 45 and 46; d) the names of the manager and the staff of the service of prevention and protection, and competent doctor .

#	Subject	Law	Link	Content (English)
				2. The employer shall also ensure that each worker receives adequate information: a) the specific risks it is exposed in relation to the activity , safety regulations and company regulations ; b) about the dangers associated with the use of dangerous substances and preparations on the basis of safety data sheets provided by law and by the rules of good practice ; c) the measures and activities for protection and prevention measures taken. 3. The employer shall provide the information referred to in paragraph 1, letters a) and paragraph 2 , letters a), b) and c) , to the workers referred to in Article 3 , paragraph 9. 4. The content of the information must be easily understandable for workers and must enable them to acquire the relevant knowledge. Where the information relates to immigrant workers, it is done after checking the understanding of the language used in the path information. Penalties - Penalty Penalties for the employer and the executive • Article 36, para. 1 and 2: arrest of two to four months, or a fine from EUR 1315.20 to 5699.20 [Art 55, para. 5, letter. c)] ORDERS TO IMPLEMENT MINISTERIAL DECREE March 27, 2013 - Simplification in the field of information, training and health surveillance of workers seasonal agriculture Bullets Art. 36: Article 37 - Training of workers and their representatives 1. The employer shall ensure that each worker receives sufficient training and adequate health and safety, including with respect to language skills , with particular reference to: a) concepts of risk , harm, prevention , protection, organization of corporate prevention , rights and duties of the various corporate entities , supervisory , control, assistance ; b) risks relating to the duties and the possible damage and the resulting measures and procedures for prevention and protection characteristics of the sector or company to which they belong .

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				2. The duration, the minimum content and the mode of training referred to in paragraph 1 shall be established by agreement of the Permanent Conference for relations between the State, the Regions and the Autonomous Provinces of Trento and Bolzano adopted after consultation of the social partners within the period of twelve months from the date of entry into force of this Decree. 3. The employer shall ensure also that each worker receives sufficient training and adequate in relation to the specific risks of the securities referred to in this Decree after I. Without prejudice to the provisions already in force, the training period referred to above is defined by the Agreement referred to in paragraph 2. 4. The training and , where applicable, specific training must take place at : a) the establishment of an employment relationship or the beginning date of the case of labor supply ; b) the transfer or change of duties; c) the introduction of new work equipment or new technologies , new dangerous substances and preparations . 5. The training is carried out by an expert and in the workplace. 6. The training of workers and their representatives should be repeated periodically in relation the evolution of risks or the occurrence of new risks. 7. The officers and officers received by the employer, adequate and appropriate training and regular updates in relation to their duties in the field of health and safety at work. The contents of the training referred to in this paragraph include: a) the main actors involved and their obligations; b) the definition and identification of risk factors; c) risk assessment; d) identification of technical, organizational and procedural prevention and protection. 7-bis . The training referred to in paragraph 7 may also be done at the joint bodies referred to in Article 51 or building schools, if any, or at the trade union of employers or workers . 8. The entities referred to in Article 21, paragraph 1, may avail themselves of the training courses specifically defined by the Agreement referred to in paragraph 2, the Permanent Conference for relations between the State , the Regions and the Autonomous Provinces of Trento and Bolzano .

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				9. The workers in charge of fire prevention and firefighting, evacuation of the workplace in the event of serious and imminent danger, rescue, first aid and emergency management in general should receive adequate and appropriate training and periodic updates, pending the enactment of the provisions referred to in paragraph 3 of Article 46 shall continue to apply the provisions of the Decree of the Minister of the Interior on March 10, 1998, published in SO the G.U. n . 81 of 7 April 1998 implementing Article 13 of the Decree of 19 September 1994 n . 626 (N) . 10. The representative of the workers' right to security has undergone special training in the field of health and safety concerns relating to specific risks existing in areas in which it conducts its representation, so as to assure adequate expertise on key techniques of control and prevention of the risks. 11. The format, duration and specific content of the training of the workers' representative for safety are established within the national collective bargaining , in accordance with the following minimum contents : a) principles of Community law and national law; b) general and special legislation on health and safety at work; c) the key actors involved and their obligations; d) definition and identification of risk factors ; e) risk assessment; f) identification of technical, organizational and procedural prevention and protection; g) regulatory aspects of workers' representative ; h) notions of communication technology. The minimum course duration is 32 hours early, including 12 on specific risks in the company and the resulting measures of prevention and protection measures adopted, with verification of learning. The national collective bargaining governs the obligation of regular updating, the duration of which cannot be less than 4 hours per year for companies employing 15 to 50 employees and eight hours per year for companies employing more than 50 workers. 12. The training of workers and their representatives must, in collaboration with the joint bodies, where they exist in the field and in the area in which the place of business of the employer, during working hours and may not result in economic burden to the workers. 13. The content of the training must be easily understandable for

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				workers and must allow them to acquire the necessary knowledge and skills in the field of health and safety at work. Where the training relates to immigrant workers, it takes place after verification of understanding and knowledge of the target language used in the training process. 14. The skills acquired in the course of training referred to in this Decree shall be recorded in the citizen's training booklet referred to in Article 2 , paragraph 1, letter i) of the Legislative Decree of 10 September 2003 n . 276 (N) , as amended, if actually available as activated in accordance with with applicable regulations. The content of the training booklet is considered by the employer for the purposes of planning and training of supervisors shall take it into account for the purpose of verification of the obligations under this Decree. In all cases, training and updating, under this Decree for managers, supervisors, workers and workers' representatives for the security in which the contents of the training courses overlap, in whole or in part, is the recognized training credit for the duration and content of training and match provided. The procedures for Recognition of credits and the models by which documented the successful formation are identified by the Permanent Conference for relations between the State , the regions and the autonomous provinces of Trento and Bolzano , after consulting the Standing Advisory Commission referred to in Article 6. Education institutions and university shall issue to the students treated the workers in accordance with Article 2 , paragraph 1, letter a) , and Article 37 , paragraph 1, letters a) and b) of this Decree , the certificates of successful training on health and safety at avoro.41 Sanctions - Penalty Penalties for the employer and the executive • Article 37 , para. 1, 7, 9 and 10: imprisonment from two to four months or a fine from EUR 1315.20 to 5699.20 [Art 55 , para. 5, letter . c)] ORDERS TO IMPLEMENT Agreement between the Ministry of Labor and Social Policy , the Ministry of Health , the regions and the autonomous provinces of Trento and Bolzano for the

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				training of workers, in accordance with Article 37 , paragraph 2, of the legislative decree 9 April 2008, no . 81. MINISTERIAL DECREE March 6, 2013 - Qualification criteria of the role of trainer for the health and safety at work
8	HSE training (common principles , obligations, sanctions)	D.lgs. 9 Aprile 2008, n. 81 - Testo Unico sulla salute e sicurezza sul lavoro	http://www.lavoro.gov.it/SicurezzaLavoro/Documents/TU%2081-08%20-%20Ed.%20Ottobre%202013.pdf	2. IDENTIFICATION AND REQUIREMENTS OF TRAINEES The lectures will be made, with regard to the various topics, from personal training experience, documented, at least two years, in the area of prevention, health and safety in the workplace, and personal training experience, documented, at least two years in the techniques involving the use of access systems and positioning ropes and their use in the workplace. 3. RECIPIENTS OF COURSES Are recipients of the courses: a) workers carrying working at a height with use of access systems and positioning ropes; b) operators with monitoring function of the work referred to in paragraph a) as required by paragraph 1 letter e) 116; c) any other relevant parties (employers, self-employed workers, staff supervision and inspection etc.).
9	Inspection and maintenance of lifts	Dir 29 June 1995 n. 95/16/EC ANNEX I - ESSENTIAL HEALTH AND SAFETY REQUIREMENTS RELATING TO THE INSPECTIO	http://www.ispesl.it/norme/Accessibile/main.aspx?view=showdoc&ClickLink=true&exp_coll=dir01995062900016au0001a&iddoc=dir019950629000016au0001a&selnode	6. INSTRUCTIONS FOR USE 6.1. The safety components listed in ' Annex IV must be accompanied by an instruction manual drawn up in an official language of the Member State of the lift installer or another Community language acceptable to him, so that: - assembly, - the connections, - the adjustment, - the maintenance, can be carried out safely and correctly. 6.2. Each lift must be accompanied by documentation drawn up in

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		N AND MAINTENANCE OF LIFTS AND SAFETY COMPONENTS	=dir0199506290016au0001a&url=ShowDoc('dir0199506290016au0001a')	/ tongue / official and / of the Community, it / s may / can be determined / and, in accordance with the Treaty by the Member State in which the lift is installed. This documentation shall include at least: - an instruction manual containing the plans and diagrams necessary for normal use and maintenance, inspection, repair, periodic checks and the rescue operations referred to in paragraph 4.4; - a logbook in which repairs can be noted and, where appropriate, periodic checks.
10	Inspection and maintenance of lifts	Presidential Decree of 30 April 1999 no. 162 Regulations for the implementation of Directive 95/16/EC on lifts and simplification of the procedures for granting clearance for lifts and elevators, as well as of its operating license.	http://www.ispesl.it/norme/Accessibile/main.aspx?view=showdoc&ClickLink=true&exp_coll=dpr01999043000162&iddoc=dpr0199904300162&selnode=dpr0199904300162&url=ShowDoc('dpr01999043000162')	Article 15 - Maintenance 1 For the purposes of preservation of the plant and of its normal operation, the owner or his authorized representative are required to entrust the maintenance of the whole system of the lift or hoist a person with a certificate of competency or a specialized company that is Community operator with specialization must ensure that equivalent means of authorized personnel. The certificate is issued by the prefect, following the favorable outcome of a test theory and practice, to be incurred before the appropriate Board of Examiners in accordance with Articles 6, 7, 8, 9 and 10 of the Presidential Decree of December 24, 1951, n. 1767. 2 The maintainer also ensures the emergency maneuver which, in case of need, can also be done by custodial staff trained for this purpose. 3 The maintainer shall, periodically, in accordance with the requirements of the system: a) to ensure the smooth operation of mechanical, hydraulic and electrical systems and, in particular, of the landing doors and locks; b) to verify the state of conservation of the ropes and chains; c) to the normal operations of cleaning and lubrication of the parts. 4 The maintainer shall, at least once every six months for the lifts and at least once a year for the elevator: a) to verify the integrity and efficiency of the parachute, speed limiter and other safety devices; b) to verify in detail the ropes, chains and their attacks;

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				c) to check the insulation of the electrical system and the efficiency of the connections with the land; d) to record the results of these tests on the book referred to in Article 16. 5 The maintainer promotes also promptly repair and replacement of worn or broken parts, or to test the occurred and correct execution. 6 The owner or his authorized representative shall promptly repairs and replacements. 7 In the case where the maintainer to detect a hazard in place, must stop the plant until it has been repaired and informed in a timely manner, the owner or his authorized representative and the person responsible for conducting periodic audits, as well as the common the adoption of any measures of competence.
11	Lifting of loads and people in construction industry.	D.Lgs 626/94 - D.Lgs 359/99: Titolo III	http://www.ispesl.it/sitodts/Linee_guida/LinGui359.pdf	D. Lg.vo 359/99 for the construction industry handling of loads. Adaptation to D. Lg.vo 359/99 for the construction industry handling of loads and lifting people. The legislation covers lifting equipment including lifting accessories, steel wire rope slings, chain slings, interference of loads and structures, interference equipment during service, interference equipment out of service, influence of weather conditions, lifting equipment, lifting and lowering of persons with baskets and platforms, work platform suspended on the hook.
12	Lightning protection	Circ. 28 December 2004, n. 13 ISPESL Guidelines for sample testing of earthing and lightning (DPR 462/01)	http://www.ispesl.it/norme/accessibile/main.aspx?exp_coll=c0002004122800013&view=showdoc&iddoc=c00020041228000013&selnode=c00020041228000	1. Scope of Presidential Decree 462/01 2. Meaning and purpose of the audit sample of earthing and lightning 3. Sampling parameters and frequency of testing of earthing and lightning 4. Administrative procedures for the verification 5. Verification procedures 6. Relationships with ASL, ARPA, the Supervisory Bodies, Chamber of Commerce

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13	Lightning protection	DPR of 22 October 2001, no. 462 Rules to simplify the procedure for reporting of installations and equipment for protection against lightning, grounding devices of electrical and dangerous electrical systems	http://www.ispesl.it/norme/accessibile/main.aspx?exp_coll=dpr02001102200462&view=showdoc&iddoc=dpr02001102200462&selnode=dpr02001102200462	Installations with risk of explosions require periodic checks, see e.g.: CHAPTER II - electrical grounding and protective equipment against lightning Article 4 - Periodic checks - Persons eligible 1 The employer is obliged to carry out regular maintenance of the system, as well as to submit the same to periodic review every five years, with the exception of those installed on construction sites, in rooms used for medical purposes and in environments with higher risk in case of fire for which the periodicity is biennial. 2 For the conduct of the audit, the employer turns ASL or ARPA or any organisms identified by the Ministry of Productive Activities, based on criteria established by the European technical standards UNI CEI. 3 The person who performed the periodic verification issues the final report to the employer who must keep it and show it at the request of the supervisory bodies. 4 The tests are expensive and the costs for their execution are borne by the employer.
14	Powered lines	EXECUTIVE DECREE of May 30, 2013 Ministry of Labour and Social Policy		List of companies authorized to carry out work on energized electrical powered industrial frequency to voltage exceeding 1000V Article 1 1. Following the positive opinion referred to in paragraph 2.1.a) of Annex I of the DM 04:02:11 , publication of the list referred to in point 3.4 of Annex I of the said decree , the companies authorized to carry out work on energized electrical systems powered industrial frequency voltage greater than 1000V , annexed hereto, which is integral part of this Decree. Article 2 1. Inclusion on the list of authorized companies referred to in Article 1 , paragraph 1, valid for three years from the date of

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				authorization. 2. Companies authorized must notify the Ministry of Labor and Social Policy, pursuant to point 2.1.e) of Annex I of the Ministerial Decree 04:02:11 , major accidents or serious injuries falling within the scope of the aforementioned DM 4:02:11. Article 3 1. The Ministry of Labor and Social Policy, through the Commission referred to the DM 04:02:11, within the validity period of three years of enrollment in the list of authorized companies can proceed with the inspection of the permanence of the requirements set out in Annex II to that DM 04:02:11, of these authorized companies. 2. Any change in the state of law or fact, that the authorized companies intending to operate, it must be communicated to the Ministry of Labor and Social Policies, with the assent of the Commission referred to the DM 4:02:11, will be speaking about the admissibility or otherwise communicated to the change. 3. As a result of serious breaches of authorized companies, having consulted by the Commission in DM 04:02:11, entry in the list of authorized companies is suspended with immediate effect. In cases of particular gravity will delete from the list above. This Decree shall be published on the website of the ministry of labor and social policies. Directorate General of Industrial Relations and Labor Relations - Paul Onelli

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15	Pressure equipment	D.lgs. 9 Aprile 2008, n. 81 - Testo Unico sulla salute e sicurezza sul lavoro	http://www.lavoro.gov.it/SicurezzaLavoro/Documents/TU%2081-08%20-%20Ed.%20Ottobre%202013.pdf	ANNEX V SAFETY REQUIREMENTS OF WORK EQUIPMENT CONSTRUCTED IN THE ABSENCE OF LAWS AND REGULATIONS FOR IMPLEMENTATION OF COMMUNITY DIRECTIVES OF THE PRODUCT, OR MADE AVAILABLE OF PREVIOUSLY EMPLOYED AT THE TIME OF THEIR ADOPTION PART II - ADDITIONAL REQUIREMENTS APPLICABLE TO WORK EQUIPMENT SPECIFICATIONS 1 Requirements for Pressure Equipment 1.1 The equipment, assemblies and systems subjected to pressure of liquids, gases, vapors, and mixtures thereof, shall be designed and constructed in accordance with the requirements of resistance and suitability for use established by the provisions in force, in particular assessing the risks due the pressure and temperature of the fluid in respect of the strength of the material of the equipment and the surrounding environment to the same equipment. ANNEX IV CARDS DATA SHEET FOR PRESSURE EQUIPMENT

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16	Protection from chemical agents.	Title IX of Chapter 1 of Legislative Decree 81/08 on the protection from chemical agents. Legislative Decree 25/02 (constituent Title VII bis of Legislative Decree 626/94). Implementation of Directive 98/24/EC of 04/07/98.	http://www.puntosicuro.info/documenti/documenti/120627_Arpa_linee_guida_valutazione_rischio_esposizione.pdf	Guidelines for the Assessment of Risk from exposure to hazardous chemicals and carcinogens and mutagens ", 2011 version, the document prepared by the Interagency Center" Hygiene and Safety "ISPRA, in collaboration with the Polytechnic University of Marche, the Environment Agency (England), the Scottish Environmental Protection Agency (SEPA), the Harp Basilicata, Emilia Romagna, Liguria, Piedmont, Campania, Marche and Sicily. MSDS cover: 1 Identification of the preparation and the company 2 Composition / information on ingredients 3 Hazards identification 4 First aid measures 5 Fire-fighting measures 6 Measures in case of accidental spillage 7 Handling and Storage 8 Exposure controls / personal protection 9 Physical and chemical properties 10 Stability and reactivity 11 Toxicological information 12 Ecological information 13 Disposal considerations 14 Transport Information 15 Regulations 16 Other information Exposure controls / personal protection To minimize worker exposure, the range of precautionary measures should be taken during use. Before it becomes necessary to take engineering measures, the personal protective equipment should to be used with the information already provided in 7.1. Any specific control parameters such as limit value or organic standards and information about the currently recommended monitoring procedures shall be indicated. The type of equipment is differentiated according to the type of personal protective equipment may need: • breathing apparatus, masks and filters, in the case of exposure to gas or dust (protection respiratory); • gloves and any other measures of protection of the skin and hands (hand protection);

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				• apron, boots and full protective suit, if it is not the skin of the hands, and any hygiene measures and, where necessary, the reference to the relevant CEN standards (protection skin); • equipment such as safety glasses, goggles, face shield, in the case of eye protection.
17	Protection of flora and fauna from impact of windfarms.	European guidance document	http://www.anev.org/wp-content/uploads/2012/05/Eu-Commission_Wind-energy-development-and-Natura-2000_201	Please note that this document only provides guidance for on wind energy development in accordance with the EU nature legislation and it does not address any inspection or audit requirements. Nevertheless, the document provides is useful information on: a. potential impacts of wind energy developments on nature and wildlife, b. recommendations and resolutions adopted by international conventions on the potential impact of wind farms on wildlife and habitats. EUROPEAN COMMISSION, 2010. WIND ENERGY DEVELOPMENT AND NATURA 2000 The purpose of this document is to provide guidance on how best

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			0.pdf http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2001:197:0030:0037:EN:PDF http://www.scotland.gov.uk/Resource/Doc/927/0011861.pdf	to ensure that wind energy developments are compatible with the provisions of the Habitats and Birds Directives. As such, the document is designed principally for use by competent authorities and developers, as well as consultants, site managers and other practitioners who are involved in the planning, design, implementation or approval of wind farms plans or projects. Two other key pieces of EU environmental legislation are directly relevant to wind farm developments: - Directive 2001/42/EC on the evaluation of the effects of certain plans and programs on the environment (commonly referred to as 'SEA' Directive)34. The objective of this Directive is to provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programs with a view to promoting sustainable development, by ensuring that, in accordance with this Directive, an environmental assessment is carried out of certain plans and programs which are likely to have significant effects on the environment. - Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment, amended in 1997 (97/11/EC) and 2003 (2003/35/EC) – commonly referred to as the 'EIA' Directive35. Article 3: The environmental impact assessment shall identify, describe and assess in an appropriate manner, in the light of each individual case and in accordance with Articles 4 to 11,the direct and indirect effects of a project on the following factors: —human beings, fauna and flora; —soil, water, air, climate and the landscape; —material assets and the cultural heritage; —the interaction between the factors mentioned in the first, second and third indents.

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18	Protection of workers against electrical shock.	TESTO UNICO TITLE III - USE OF WORK EQUIPMENT AND PERSONAL PROTECTIVE EQUIPMENT CHAPTER III - PLANT AND ELECTRICAL EQUIPMENT	http://www.lavoro.gov.it/SicurezzaLavoro/Documents/TU%2081-08%20-%20Ed.%20Ottobre%202013.pdf	CHAPTER III - PLANT AND ELECTRICAL EQUIPMENT Article 80 - Obligations of the employer 1. The employer shall take the necessary measures to ensure that workers are protected from all electrical hazards associated with the use of materials, equipment and electrical equipment made available to them and , in particular, those arising from: a) direct electrical contact ; b) indirect electrical contacts ; c) initiation and propagation of fires and burns due to dangerous overheating , arcing and radiation ; d) initiation of explosions ; e) Direct and indirect lightning strikes ; f) Surge ; g) any other reasonably foreseeable fault conditions . 2. To this end, the employer shall conduct an assessment of the risks referred to in paragraph 1, taking into consideration: a) the conditions and the specific characteristics of the job, including any interference ; b) the risks present in the workplace; c) all foreseeable operating conditions . 3. Following the assessment of electrical hazards, the employer shall take technical and organizational necessary to eliminate or minimize the risks present, to identify protective and collective Individual needed for the safe conduct of work and to develop procedures for use and maintenance over time to ensure the permanence of the level of safety attained by the adoption of the measures referred to in paragraph 1. 3-bis . The employer shall, also , take necessary measures to ensure that the operation and maintenance procedures referred to in paragraph 3 are prepared and implemented taking into account the laws of, the indications contained in the user manuals and maintenance of equipment falling in the specific directives of the product and then those specified in the relevant standards tecniche.59

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19	Provision of information, training, instruction and supervision in local language	Health and Safety at Work Directives 89/391 (Framework)	http://europa.eu/legislation_summaries/employment_and_social_policy/health_hygiene_safety_at_work/index_it.htm http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:31989L0391	**Council Directive 89/391/EEC** of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work. Article 9. Various obligations on employers 1. The employer shall: (a) be in possession of an assessment of the risks to safety and health at work, including those facing groups of workers exposed to particular risks; (b) decide on the protective measures to be taken and, if necessary, the protective equipment to be used; (c) keep a list of occupational accidents resulting in a worker being unfit for work for more than three working days; (d) draw up, for the responsible authorities and in accordance with national laws and/or practices, reports on occupational accidents suffered by his workers. Article 10. Worker information: 1. The employer shall take appropriate measures so that workers and/or their representatives in the undertaking and/or establishment receive, in accordance with national laws and/or practices which may take account, inter alia, of the size of the undertaking and/or establishment, all the necessary information concerning: (a) the safety and health risks and protective and preventive measures and activities in respect of both the undertaking and/or establishment in general and each type of workstation and/or job; (b) the measures taken pursuant to Article 8 (2). 2. The employer shall take appropriate measures so that employers of workers from any outside undertakings and/or establishments engaged in work in his undertaking and/or establishment receive, in accordance with national laws and/or practices, adequate information concerning the points referred to in paragraph 1 (a) and (b) which is to be provided to the workers in question. 3. The employer shall take appropriate measures so that workers with specific functions in protecting the safety and health of workers, or workers' representatives with specific responsibility for the safety and health of workers shall have access, to carry out their functions and in accordance with national laws and/or practices, to:

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				(a) the risk assessment and protective measures referred to in Article 9 (1) (a) and (b); (b) the list and reports referred to in Article 9 (1) (c) and (d); (c) the information yielded by protective and preventive measures, inspection agencies and bodies responsible for safety and health. Article 11. Consultation and participation of workers 1. Employers shall consult workers and/or their representatives and allow them to take part in discussions on all questions relating to safety and health at work. (...) 6. Workers and/or their representatives are entitled to appeal, in accordance with national law and/or practice, to the authority responsible for safety and health protection at work if they consider that the measures taken and the means employed by the employer are inadequate for the purposes of ensuring safety and health at work. Workers' representatives must be given the opportunity to submit their observations during inspection visits by the competent authority. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of Regions on the practical implementation of the provisions of the Health and Safety at Work Directives 89/391 (Framework), 89/654 (Workplaces), 89/655 (Work Equipment), 89/656 (Personal Protective Equipment), 90/269 (Manual Handling of Loads) and 90/270 (Display Screen Equipment) [COM(2004) 62

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20	Relevant standards for WTGs / wind farms in Italy.			Reference laws and regulations on energy and wind power plants in Italy. The following section provides regulations and laws to be respected for the design and construction of wind farms , sizing , noise pollution regulations , national regulations : WIND POWER PLANT - ELECTRICAL The rules and laws to be respected reference for the design and construction of wind farms are: IEC 64-8 : Electrical systems using a nominal voltage not exceeding 1000 volts for alternating current and 1500 volts for direct current ; CEI 11-20 : Equipment for the production of electricity and UPS connected to networks of category I and II ; IEC 61400-1 : Wind turbine generator systems ; IEC 61000-3-2 : Electromagnetic compatibility (EMC) - Part 3: Limits Section 2: Limits for harmonic current emissions (equipment input current 16 A per phase) ; CEI EN 60555-1 : Disturbances in supply systems produced by household appliances and similar electrical equipment - Part 1: Definitions ; IEC 60439-1-2-3 : gear assemblies for low-voltage switchgear and control gear ; IEC 60445 : Identification of terminals and devices , and the ends of the conductors designated and general rules for an alphanumeric system ; IEC 60529: Degrees of protection provided by enclosures (IP code) ; IEC 60099-1-2 : Arresters ; CEI 20-19 : Rubber insulated cables with a rated voltage not exceeding 450/750 V; CEI 20-20 : Polyvinyl chloride insulated cables with a rated voltage not exceeding 450/750 V; IEC 81-1 : Protection of structures against lightning; IEC 81-3 : Mean values of the number of lightning strikes to earth per year and per square kilometer ; IEC 81-4 : Assessment of risk due to lightning ; CEI 0-2 : Guidance for the definition of project documentation for electrical installations; CEI 0-3 : Guidance for the compilation of the documentation; DM 22 01 08 No 37 Regulations on the implementation of Article 11, paragraph 13 , letter a) of Law no. 248 of 2 December 2005 laying down provisions for the reorganization of the business of

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				installation of the equipment inside the buildings ; Legislative Decree -387 ; Legislative Decree of April 2008, no . 81: Implementation of Article 1 of the Law of 3 August 2007, n . 123, concerning the protection of health and safety in the workplace; Law no. 239/2004; Resolution Authority for Electricity and Gas. 34/ 05; Resolution Authority for Electricity and Gas. 88/ 07; Resolution Authority for Electricity and Gas. 89/ 07; Under the system of exchange of electricity , apply 28-06 of the Authority for Electricity and Gas 10 February 2006: " Technical and economic conditions of the service of net metering of electricity by plants powered by renewable sources of power input not exceeding 20 kW , in accordance with Article 6 of Legislative Decree no. 29dicembre 2003, n. 387 "and subsequent amendments and additions. The feed-in must be in accordance with CEI 11-20 (published August 2000) and CEI 11-20; V1 (published August 2004), in particular the protection of the interface between the network and the wind power plant can be integrated in the control system of the inverter. PLINTO FOUNDATION The sizing must conform to the following standards and subsequent amendments and additions: Ministerial Decree Public Works 09/01/1996 (OJ 05.02.1996 n . 29th suppl . Ord . N. 19) (Technical standards for calculation, execution and testing of reinforced concrete structures and for metal structures); Ministerial Decree Public Works 16/01/1996 (OJ 05.02.1996 n . 29th suppl . Ord . N. 19) (Rules on "General criteria for the verification of the safety of constructions, loads and overloads") ; Circ. the Ministry of Public Works 04/07/1996 n . 156AA.GG./STC. (OJ 151 of 09.16.1996) (Click for application of the " Technical rules applicable to the general criteria for the verification of the safety of constructions, loads and overloads" the Ministerial Decree of 16/01/1996) . REGULATORY IMPACT - ACOUSTIC Prime Ministerial Decree of March 1, 1991: Limits of exposure to noise in residential areas and in the external Environment;

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				Law 477 of 26/10/1995: Framework Law acoustic; Prime Ministerial Decree of 14/11/1997: Determination of the limits of the sound sources. NATIONAL REGULATIONS Ministerial Decree of July 5, 2012 Legislative Decree nr.28 March 3, 2011 - Implementation of Directive 2009/28/EC on the promotion of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC Legislative Decree n. 387 29/12/2003 : "Implementation of Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market " ; Law No. 224: Provisions for the preparation of the annual and multi-year State (Finance Act 2008) ; Legislative Decree n . 115 of 30/05/2008 : "Implementation of Directive 2006/32/EC on energy end-use efficiency and energy services and repealing Directive 93/76/EEC " ; DECREE December 18, 2008 : Incentives for the production of electricity from renewable sources, as defined in Article 2, paragraph 150 , of the Law of 24 December 2007, n. 244 ; DECREE October 17, 2007 : Minimum uniform criteria for defining conservation measures relating to Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).
21	Requirements for on-site epoxy paint repairs	Ministerial Decree of 12 July 2007 no. 155 Ministry of Health Implementation Regulations of ' Article 70, paragraph 9 , of	http://www.ispesl.it/norme/accessibile/main.aspx?exp_coll=dm002007071200155&view=showdoc&iddoc=dm00200707120155&selnode=dm0020070712 00155	Leg. September 19, 1994, n. 626 (see below) is amended. This (may) affect workers in contact with epoxy resins: Article 1 - Scope, purpose and scope 1 The regulation applies to public or private sectors of activity covered by the scope of Legislative Decree 19 September 1994, no. 626, as amended. 2 The data relating to health assessments and subsequent recording of the same in the medical records or in the register referred to in the following articles may be used only for the purposes of health and safety at work. Article 2 - Register of workers exposed to carcinogens 1 The register of workers exposed to carcinogens referred to '

#	Subject	Law	Link	Content (English)
		Legislative Decree 19 September 1994, no. 626. Records and medical records of workers exposed to carcinogens at work.		Article 70, paragraph 1, of Legislative Decree 19 September 1994, no. 626, as amended, is established by the employer, in accordance with the model provided in ' Annex 1, which forms an integral part of this Regulation and compiled on the basis of the assessment referred to in Article 63 of the aforesaid legislative decree n. 626 of 1994. 2 The register referred to in paragraph 1 is made up of sheets bound and numbered consecutively. 3 The employer sends in a sealed envelope, signed by the physician in charge, a copy of the register referred to in paragraph 1 Institute for Prevention and job security (ISPESL) and the supervisory body responsible for the area within thirty days of its establishment. Article 3 - Folder health and risk 1 The medical records and risk, referred to in Articles 17 and 70 of Legislative Decree 19 September 1994, no. 626 are compiled in accordance with the model provided in ' Annex 2 which is an integral part of this Regulation. 2 The documents referred to in paragraph 1 are made from sheets bound and numbered consecutively. 3 adoption is permitted for medical records and risk than the model provided in ' Annex 2 , provided that there are, however, including the data and information specified in that Annex. 4 Notwithstanding the provisions of Article 162 of the Decree of the President of the Republic of 30 June 1965 no. 1124 medical records referred to in paragraph 1 may also be used for health surveillance provided for in ' Article 16 of Legislative Decree 19 September 1994, no. 626. 5 In the case of workers simultaneously exposed to ionizing radiation and carcinogens for which it is established personal health document under ' Article 90 of the Legislative Decree of 17 March 1995 n. 230, except that the document should be integrated with the information specified in the model set out in ' Appendix 2. 6 The preservation of health data collected must be insured for 40 years from the termination of the work involving exposure to carcinogens. 7 The storage of the data collected must be insured for 30 years from the termination of the work involving exposure to ionizing radiation, and should be deleted after this deadline from the medical record only if such data are not indispensable as a source

#	Subject	Law	Link	Content (English)
				of information polyvalent also in relation to their exposure to carcinogens
22	Requirements for on-site welding repairs	D.lgs. 9 Aprile 2008, n. 81 - Testo Unico sulla salute e sicurezza sul lavoro	http://www.lavoro.gov.it/SicurezzaLavoro/Documents/TU%2081-08%20-%20Ed.%20Ottobre%202013.pdf	ANNEX V SAFETY REQUIREMENTS OF WORK EQUIPMENT CONSTRUCTED IN THE ABSENCE OF LAWS AND REGULATIONS FOR IMPLEMENTATION OF COMMUNITY DIRECTIVES OF THE PRODUCT, OR MADE AVAILABLE OF PREVIOUSLY EMPLOYED AT THE TIME OF THEIR ADOPTION PART II - ADDITIONAL REQUIREMENTS APPLICABLE TO WORK EQUIPMENT SPECIFICATIONS 5 Requirements applicable to specific work equipment 5:14 Installations and oxyacetylene welding or cutting torch , electrical and similar 5.14.1 Among combustion plants or flame devices and generators or gas tanks of acetylene must pass a minimum distance of 10 meters , can be reduced to 5 meters , where the generators or gas tanks are protected against sparks and l ' radiation of heat or used to work outside 5.14.2 On derivations of acetylene gas or other combustible gas supply in the welding torch , to include a hydraulic valve or other safety device that corresponds to the following requirements : a) prevents the return of flame and the flow of oxygen or air in the pipes of fuel gas ; b) allow a safe control at all times of its efficiency ; c) be constructed so as not to constitute a hazard in the event of any outbreak Welcome Return to flame .

#	Subject	Law	Link	Content (English)
				5.14.3 The equipment for electric welding or similar operations shall be equipped with double pole switch on the primary circuit of the derivation of the electric current. 5.14.4 When welding or other similar operation is not carried out with welding machine driven by the rotating machine of conversion, it is forbidden to perform operations of electric welding with direct derivation of the current of the normal distribution line without the use of a transformer having winding isolated from the primary to the secondary. ANNEX VI PROVISIONS CONCERNING THE USE OF WORK EQUIPMENT 8 Plant and oxyacetylene welding or cutting, oxy-hydrogen, electricity and the like 8.1. They should not be executed work and tasks with an open flame or any incandescent material less than 5 meters away from the generators or gas tanks of acetylene. 8.2. The inside of the transport companies and work places of the mobile devices to the welding torch must be carried out by means of assuring the stability of the gas generators and containers of compressed gases or dissolved and to avoid dangerous impacts . 8.3. The containers of compressed gas or loose, use of stationary welding, shall be effectively anchored, in order to prevent an accidental fall. 8.4. Do not perform any welding or cutting torch or electrically, under the following conditions: a) on containers or closed tubes ; b) on open tubes or containers containing substances which under the action of heat may result in an explosion or other dangerous reactions ; c) of containers or pipes which have also opened which contained substances evaporate under the action of heat may result in an explosion or other dangerous reactions . It is also forbidden to perform welding operations in the interior of the premises, containers or would that not be effectively ventilated. When hazardous conditions laid down in point a) of the first paragraph of this article can be eliminated with the opening of a closed container , with the removal of hazardous materials and their

#	Subject	Law	Link	Content (English)
				residues , with the use of inert gases or by other means or measures, welding and cutting operations can also be performed on the container or piping indicated to the same letter a) of the first subparagraph , provided that the measures are prepared by an experienced safety and carried out under his direct supervision . 8.5. In welding and similar electrical inside metal containers, subject to compliance with the provisions of paragraph 8.4, shall be designed and used means isolated electrode clamps completely protected so that the worker is defended against the dangers arising from accidental contact with live parts voltage. The same operations must also be carried out under the continuous supervision of an expert to assist the worker from the outside of the container
23	Rope access.	Guidelines "temporary work at heights" - Guidelines for temporary work at a height with the use of rope access and positioning techniques ropes.	http://www.ispesl.it/sitodts/Linee_guida/linea%20guida%20funi.pdf	The Legislative Decree July 8, 2003, # 235: "Implementation of Directive 2001/45 / EC on minimum safety and health requirements for the use of work equipment by workers " contains general and specific provisions relating to minimum safety requirements and health requirements for the use of work equipment most commonly used in performing work temporary quota: scaffolding, ladders with rungs and access systems and positioning with ropes. This guideline, which is for temporary work at height, where access, positioning and the output from a workplace use is made of ropes, provides guidance relating to minimum contents of the document of risk assessment, the performance criteria and measures for safe use for the performance of this particular activity in which the operator is constantly exposed to the risk of falling. The main purpose is to facilitate the task of the employer in a particular sector activity, characterized by the predominant presence of small businesses, where the safety and health of workers, constantly exposed to particularly high risks depend mainly correct use of such equipment. The work rope must be equipped with safe means of ascent and descent and must equipped with a self-locking system to prevent the fall in the event that the user loses control of their movements. This safety condition is realized with descenders A-EN341 and EN566 lockers. (....) In exceptional circumstances where, in view of

#	Subject	Law	Link	Content (English)
				the risk assessment, the use of a second rope would make the work more objectively dangerous, may be permitted to use the single rope work, provided it is possible to adopt security measures at least equivalents, such as greater protection of the rope, the possibility of recovering the operator quickly (even by means of the same work rope), the visual inspection constant operator by an assistant and that the use of the one rope is limited only to the phases of displacement along the rope itself. (....) Art. 36-d (Obligations of employers regarding the use of access systems and positioning by means of ropes). - 1. The employer employs access systems and positioning using ropes in accordance with the following requirements: a) system comprising at least two separately anchored ropes, one for the access, descent and support (work rope) and the other as backup (rope security). It is permissible to use a rope in exceptional circumstances in which the use of a second rope makes the most dangerous job and if appropriate measures are taken to ensure safety; b) workers with appropriate harness connected to the security rope; c) work rope equipped with safe means of ascent and descent and equipped with a self-locking system designed to prevent the fall in the event that the user loses control of its movements.
24	Safety signs	Circular 30 of July 16, 2013 concerning Safety Signs - Legislative Decree no. 81/2008	http://europa.eu/legislation_summaries/employment_and_social_policy/health_hygiene_safety_at_work/c11121_it.htm	Directive 92/58/EEC lays down minimum requirements concerning health and safety signs at work *. For example, they relate to: location and identification of containers and pipes, fire-fighting equipment, certain traffic routes, illuminated and acoustic signs, as well as the introduction of appropriate verbal communications * and hand signals *.

#	Subject	Law	Link	Content (English)
25	Safety signs	Safety Signs	http://www.vigilfuoco.it/aspx/page.aspx?IdPage=3415	Requirements for safety signs are listed in the link provided.
26	Smoking policy	D.lgs. 9 Aprile 2008, n. 81 - Testo Unico sulla salute e sicurezza sul lavoro RULING N. 6/2012 of 15/11/2012 Provisions relating to passive smoking in the workplace	http://www.lavoro.gov.it/SicurezzaLavoro/Documents/TU%2081-08%20-%20Ed.%20Ottobre%202013.pdf	Smoke is considered a hazardous substance and therefore smoking is generally prohibited in the workplace. As regards "passive smoking", the following ruling holds: RULING N. 6/2012 of 15/11/2012 - Provisions relating to passive smoking in the workplace Subject: Art. 12 of Legislative Decree no . N . 81/2008 and subsequent amendments and additions - answer to the question concerning the provisions on passive smoking in the workplace. The CSIT - Confindustria Innovative and Technological Services, the Federbingo and advanced Ascob have requested a ruling to know the opinion of this Commission regarding the possibility of admitting the presence of workers in rooms for smokers. It is confirmed that the above law admits the presence of workers in the premises reserved for smokers provided in bingo halls, of course, on the assumption that they meet the following conditions: · The premises must be adapted to the technical requirements of the DPCM of 23 December 2003 ; · the presence of officials must be temporary ; · the employer must comply with the obligations imposed by the Decree. n . 81/2008 regarding the protection of health and safety in the workplace. In this regard it should be pointed that the issue is expressed in the law governing n.3/2003 which introduced a ban on smoking in enclosed rooms. That legislation has since found specific regulation in the Circular of the Ministry of Health of 17 December 2004 which identified the type of enclosed spaces open to users or where the public is subject to the possibility of equipping smoking rooms in compliance with the technical requirements dictated by

#	Subject	Law	Link	Content (English)
				the Prime Ministerial Decree of 23 December 2003. As noted by the Ministry of Health with the callback round, Article 51 of the Law n.3/2003 pursues the primary goal of "protecting the health of non-smokers, with the objective of maximum possible extension of the smoking ban, which, as such, must be considered of general application, with the sole exception of limited exceptions as are expressly provided for . Given the above, the Commission provides the following information The smoking ban applies to all workers as "users" of the premises under which lend their activities. Paragraph 3 of this Article 51, however, states that in the hospitality rooms intended for non-smokers should have priority over the surface area of administration. This suggests that in the years where we will serve food or beverages cannot be admitted to the presence of employees in the service, even in rooms reserved for smokers. It is believed, therefore, that given the current legislation, in such spaces, even in smoking rooms can be temporarily present day workers assigned to specific tasks. However, in order to protect the health and safety of workers, subject to carry out its activities in the areas reserved for smokers, although adapted to the technical requirements dictated by the Prime Ministerial Decree of 23 December 2003, the employer must comply with the obligations imposed by the Decree Law of 9 April 2008 n . 81 , including the preliminary assessment of the presence of hazardous chemical agents in the workplace and the assessment of risks to the safety of workers arising from the presence of these agents. THE PRESIDENT OF THE COMMISSION - (Mr. Joseph Piegari)
27	Transport of people and materials in temporary construct	Guidelines Transport of people and materials in temporary constructio	http://www.ispesl.it/sitodts/Linee_guida/trasporto%20persone%20e%20material	Guidelines on the transport of people and materials between the planes defined in temporary construction. In the page 70 of the document inspection and testing requirements are listed. 7.2 - Controls and Tests: The purpose of checks and audits is to: - Ensure that the lift has been installed correctly and that its use is to be made safe - Keep under control conditions of operation in such a way as to

#	Subject	Law	Link	Content (English)
	ion	n (Part 1)	i%201%20 parte.pdf http://www.ispesl.it/sitodts/Linee_guida/trasporto%20persone%20e%20materiali%202%20parte.pdf	detect any malfunzionementi and / or deterioration which must be promptly; eliminated in order to ensure safe use of the lift in time; - Ensure that the interventions of modification and repair has been performed PROPERLY AND without jeopardizing the safe use of the lift. - Subsequent to configuration changes, accidents or repairs. The results of inspections and tests shall be entered on the register modeled annexed. The following sections address the inspection specific practices (pages 70-72): 7.2.1 - Checks before use 7.2.2 - Periodic Controls 7.2.3 - Testing 7.2.3.1- Rehearsal of Operations 7.2.3.2- Load Test 7.2.3.3- Testing Device Security Against Excess speed
28	Use of anchors in construction.	DPR 246/93	http://www.ispesl.it/sitodts/Linee_guida/Guidancoraggi.pdf	Technical Guide for the selection, use and maintenance of anchors. The theme of the anchors in the construction industry has always been highly debated , the legislation injury prevention and safety at work and that technique never face in an organic way , explicit and comprehensive the problem of how to identify , qualify, design and install these systems. The confusion stems from the fact that they can be classified according to the Construction Products Directive 89/106/EEC , implemented in Italy by DPR 246/93 , according to the PPE Directive 89/686/EEC , implemented in Italy by Legislative Decree 475/92 , according to the technical standards (eg the UNI EN 795) , according to some circular the Ministry of Labor and Social Security (in the case of the anchors of scaffolding), while for others there is in fact a precise reference. Questa guide aims to help bring clarity in the field, staring at some of the concepts that constitute the starting point for further assessment. 9 Inspection 9.1 General: Staff involved in inspection is defined as follows: Worker: is the person to whom it is intended the anchor; Installer is the qualified person performing the installation and eventual dismantling anchor. The two professions can coincide if the person

#	Subject	Law	Link	Content (English)
				is in possession the necessary requirements. 9.3 Inspection Requirements common to anchorages: The anchors must be marked legibly.. 9.3.1 Inspection before assembly: The inspection before assembly and after disassembly must be made by the editor of the anchor and be conducted with periodicity described in section 9.4 and the manner indicated in table. 9.4-1. The inspection must be carried out anyway in accordance with the manufacturer's instructions. 9.3.2 Inspection of Use: The visual inspection should be performed on anchors in use by an employee and it must be carried out in according to the manufacturer's instructions,. The worker must immediately report any defect or fault detected. 9.3.3 Periodic inspection: The periodic inspection must be carried out by the installer of the anchor and it should be conducted in accordance with the manufacturer's instructions. The checks must be a visual and / or instrumental one. The anchor must always be subjected to periodic inspection, even when the interval of installation is less than the inspection period required by the manufacturer and anchor installer, because its efficiency is closely related to the tightening of the nut. 9.3.4 Inspection of an anchor which is damaged or that has a defect: Each anchor which is damaged or that has a defect should be immediately checked by the installer or other person qualified by the manufacturer who must decide whether to keep or withdraw the anchor from service in the manner prescribed by the employer and however, in accordance with the manufacturer's instructions. 9.4 Inspection anchor: In addition to the requirements of common inspection provided for in paragraphs 9.3.1, 9.3.2, 9.3.3 and 9.3.4 each anchor should be inspected at intervals recommended by the manufacturer, and at least every six months. Before the use its the integrity of components and the effectiveness of nuts and bolts must be verified. The anchor installer must perform regular inspections. The employee must inspected each anchor daily before starting work (by using anchors) Table 9.4-1 shows a list of controls, obviously not exhaustive, to be made on the anchor and on the individual components.

#	Subject	Law	Link	Content (English)
29	Use of work platforms for forklifts	Circ. November 7, 2006, n. prot. AOO/0003633/06 ISPESL - Department Approval and Certification Work platforms for forklift trucks	http://www.ispesl.it/norme/accessibile/main.aspx?exp_coll=c0002006110700000&view=showdoc&iddoc=c00020061107000 0&selnode=c00020061107000 00	The number of queries received by both the Departments of peripheral ISPESL and is part of the Local Health / ARPA, even for short routes, show that there is a growing use of work platforms applied to the forks of the forklift purpose of lifting persons. In this respect, then it is necessary to point out that, as stated also by the Working Group of the Committee 98/37/EC, equipment to bring people (as a platform, cage, basket, etc..) not assembled with the machine lifting materials so as to constitute an integral whole, but simply raised by the machine as if it were a part of the load, just as a platform positioned on the forks of a forklift or as also a platform suspended on the hook of a crane, not constitute nor interchangeable equipment as they do not change the intended use of the machine or a lifting accessory because it does not need to connect the load to the machine, does not fall within the scope of the Machinery Directive and therefore cannot bear the marking EC. In relation to the above it is therefore clear that a truck that may use the above platform is not assembled, modified by omitting the intended use of the vehicle itself, cannot be subject to the verification requirements under Article 25 of Presidential Decree 547/55 and therefore should not be reported ISPESL its commissioning. Use of work platforms applied to the forks of the forklift in order to lift people instead falls within the scope of Directive 95/63/EC amending Directive 89/655/EEC on the use of work equipment. L ' art. 4 of Legislative Decree. 359/99 of transposition of the Directive, which has completely changed the ' art. 184 of Presidential Decree 547/55 (Lifting and transporting people), while requiring explicitly that the lifting of persons must be carried out only with work equipment and accessories provided for this purpose, however, permits - even if only by way of exception - the lifting of persons using equipment not provided for this purpose on the condition that adequate security measures are taken in accordance with the provisions of good technique. In this regard, it is useful to remember that with the technical note attached to the circular ISPESL IL 11 99/99 were indicated as useful

#	Subject	Law	Link	Content (English)
				references even if only for cages or platforms suspended from the hook of a crane, the contents of Annex C of ISO 12480-1 (Safe use of cranes) for the definition of exceptionality and evaluations of technical and organizational solutions, and the contents of the European standard EN 14502-1 for safety features of these platforms. This note must be brought to the attention of all relevant staff and local bodies responsible for overseeing both the workplace and is to carry out inspections periodically.
30	Working at height regulations	D. Decree of 8 July 2003 n. 235 Implementation of Directive 2001/45/EC on the minimum safety and health requirements for the use of work equipment by workers working at heights	http://www.ispesl.it/norme/accessibile/main.aspx?exp_coll=dlg02003070800235&view=showdoc&iddoc=dlg02003070800235&selnode=dlg02003070800235	Significant amendments to the law of 1 March 2002, n. 39, and in particular Article 1, paragraphs 1, 3 and 5. Conformant to the Directive 2001/45/EC of the European Parliament and of the Council of 27 June 2001 amending Directive 89/655/EC of the Council on minimum safety and health requirements for the use of work equipment by workers at work, particularly working at heights.

#	Subject	Law	Link	Content (English)
31	Working at height regulations	TESTO UNICO TITLE IV - TEMPORARY OR MOBILE SITES CHAPTER II - REGULATIONS FOR THE PREVENTION OF ACCIDENTS AT WORK IN CONSTRUCTION AND WORK AT A HEIGHT	http://www.lavoro.gov.it/SicurezzaLavoro/Documents/TU%2081-08%20-%20Ed.%20Ottobre%202013.pdf	CHAPTER II - REGULATIONS FOR THE PREVENTION OF ACCIDENTS AT WORK IN CONSTRUCTION AND WORK AT A HEIGHT SECTION I - SCOPE Article 105 - Activities subject 1. The provisions of this Chapter shall apply to the activities , and exercised by anyone under which workers are employed or self-employed, concerning the execution of the construction , maintenance, repair , demolition , preservation, restoration , renovation or equipment , processing, renovation or dismantling of fixed structures , permanent or temporary , masonry , concrete , metal , wood or other materials, including lines and electrical systems , road works , rail, hydraulic , marine , hydro-electric , of reclamation , forest structure and earthworks . Constitute, moreover, works of building construction or civil engineering excavations, and the assembly and disassembly of prefabricated elements used for the realization of construction works or civil engineering. The provisions of this chapter shall apply to working at heights referred to in this Chapter and in any other work.
32	Working at height regulations	Guidelines Fall Arrest Systems	http://www.ispesl.it/sitodts/Linee_guida/Fall_arrest_system_Changes.pdf	This ISPESL guideline provides indications on the minimum content of risk assessment document on the selection, use, maintenance of Personal Protective Equipment (PPE) against falls from a height, and fall arrest systems. The indications in this guideline were drafted in compliance with current laws and regulation on the prevention of accidents and hygiene at work Italian National Institute for Health and Safety at Work. (...) The body harness can be integrated into garments. Even if the body harness is part of a garment, it should still be possible to perform a visual inspection of the harness. (...) 9. USE OF FALL ARREST SYSTEM: When the system has been used for a fall arrest, it should be put out of service and prepared for inspection following instructions given in paragraph 10.2.4. 9.3. Safe Use of Anchor Lines: 9. Nearby the access to the

#	Subject	Law	Link	Content (English)
				permanent anchor line, placards with the following information should be installed: • date of installation and name of installer and manufacturer; • system identification number; • compulsory usage of an energy absorber; • maximum number of simultaneous users allowed; • operating instructions (inspections and related dates); • dates in which the system has been put out of service; • a warning indicating that the system should be used only as connection line for the fall arrester. 10.1 Type of inspections: Table 4 summarizes the general inspection requirements. (Please see page 71) 10.2 General inspections applied to fall arrest systems: For all components, check the presence and readability of the marking. 10.2.1 Fall arrest system inspection performed by workers. User should inspect, following the directions provided by manufacturers, through visual check, equipment before and after use, paying attention to every single component, e. g. body harnesses, lanyards, restraint ropes, energy absorbers, connectors. In addition, worker should inspect the internal part of equipment whenever the access is allowed. Worker should immediately report any fault or inconvenience detected during the inspection of every PPE included in the fall arrest system. 10.2.2 Periodical inspection: The periodical inspection should be performed following schedule and modes indicated in table 4, and in any case according to the directions provided by manufacturers. 10.2.3 First use or operating inspection: In addition to the conventional and periodical inspection, it is necessary to perform checks: • upon reception of new equipment; • before operating equipment after repair; • before operating equipment when stored for an extended period of time

#	Subject	Law	Link	Content (English)
				or in conditions that could compromise its state of preservation; • before operating a fixed installation, for a flexible anchor line not used for an extended period of time. 10.2.4 Inspection of a fall arrest system after a fall arrest or if faulty: After a fall arrest or if faulty, devices and equipment should be immediately put out of service and permanently marked with a label indicating their out of service conditions. The equipment should be checked by competent personnel, according to the directions provided by manufacturers who should decide whether it can be put again in service, destroyed or repaired. Repairs should be performed by the manufacturer or a competent person properly authorized by the manufacturer himself. 10.3 Body harnesses, lanyards and attachment elements inspection: In addition to what stated in paragraphs 10.2.1 and 10.2.3, every element should be inspected as scheduled by manufacturers, at least once a year. The inspection should be performed by competent personnel as well as users. Table 5 (Please see page 73) lists the checks to be performed on single components. 10.4 Fall arrester inspection: In addition to what stated in section 10.2.1, devices as in par. 6.1 and anchor lines should be inspected by competent personnel following schedules and directions provided by manufacturers, and should be put out of service in case of faults. Whenever possible, they may be sent back to manufacturer for repair. According to the directions provided by manufacturers, the following procedures should be performed: • a complete and annual inspection, disassembling and assembling included, by competent personnel and according to the directions provided by manufacturers, and in any case after a fall arrest. During every inspections, attention should be paid to: • mechanical devices - perform an accurate cleaning of every single component, check the forging folds handling and the locking devices. Check for signs of corrosion; • flexible anchor lines - check the state of lines with particular attention to wearing, cuts, tensioning, corrosion, terminals, rigidity, dirt; • rigid guides - check that the rigid guides are free of dirt, visible signs of corrosions, and that the connections are properly secured.

#	Subject	Law	Link	Content (English)
				Table 6 (Please see page 74) lists the checks to be performed on single components. 10.5 Flexible and rigid anchor line inspection: Flexible lines and rigid anchor lines should be maintained by competent personnel following schedules and directions provided by manufacturers and at least once a year if regularly used or before using it again if not used for an extended period of time. The following procedures should be performed: • inspection of anchor points; • checking tensioning of lines and of any energy absorber; • checking the ending points / ends of lines; • checking rigid rails and of their ends: permanent strains, corrosion due to rust and other pollutants, attachment of end points; • checking mobile devices permanently installed on the anchor line; • maintenance: mechanical devices should be maintained following the manufacturer's directions for use. Faulty products should be put out of service and, whenever possible, repaired by competent personnel. Anchor lines with faulty or worn elements should be put out of service. 10.6 Inspection of anchor points: Permanently installed anchor points should be inspected by competent personnel, following the manufacturer's directions as to times and modes. Inspections should be recorded. It is recommended that the date of the latest inspection should be recorded not only on the inspection and maintenance card, but also on a label to be placed near the anchor point.
33	Working at height regulations	Guidelines Installation, dismantling, processing scaffolding	http://www.ispesl.it/sitodts/Linee_guida/Monteporzio/linee%20guida%20ponteggi.pdf	Guidelines "Installation, dismantling, processing scaffolding" Guidelines for temporary work at a height with the use of rope access and positioning fixed metal scaffolding facade. Assembly, disassembly, conversion scaffolding. Please see page for inspection required for safe use of fall arrest systems.
34	Working in	DECREE OF THE		CONFINED SPACES DECREE OF THE PRESIDENT OF THE REPUBLIC September 14, 2011 ,

#	Subject	Law	Link	Content (English)
	confined space	PRESIDENT OF THE REPUBLIC September 14, 2011 , n . 177		n . 177 Regulations for the qualification of companies and self-employed workers operating in areas suspected of contamination or neighbors, in accordance with Article 6 , paragraph 8, letter g) of the legislative decree 9 April 2008, no . 81. Article 1 - Purpose and Scope 2 - Qualification in the area of suspected pollution or confined environments 3 - Safety Procedures in the area of suspected pollution or confined environments 4 - Clause invariance financial Circular no. 42 of 2010 09/12/2010 Subject: Health and safety in the workplace ; work in areas suspected of contamination. Initiatives relating to contracts for cleaning and maintenance activities which expose workers to the risk of suffocation or poisoning due to emission of toxic or harmful substances Circular no. 13 of 2011 of 19/04/2011 Subject: Health and Safety in the workplace ; work in areas suspected of contamination. Initiatives relating to contracts for cleaning and maintenance activities which expose workers to the risk of suffocation or poisoning caused by fumes toxic or harmful substances Note the 32/0010248/MA001.A001 Prot 09/05/2012 Subject: illustrated manual for work in environments suspected pollution or confined pursuant to art. 3, paragraph 3 of Presidential Decree 177/2011 TABLE OF CONTENTS INTRODUCTION 1. KEY POINTS FOR THE DEVELOPMENT OF SAFETY PROCEDURES 1.1 Measurements and preliminary precautions 1.2 Signage 1.3 Implementation of the 1.4 Information, education, training and health fitness for the specific task 2. ILLUSTRATED HISTORY 2.1 Qualification of the company 2.2 Risk analysis and operational procedure

#	Subject	Law	Link	Content (English)
				2.3 Identification of the representative of the Employer and Client information workers of the subcontractor 2.4 Risks from hazardous substances or oxygen deficiency 2.5 Personal Protective Equipment 2.6 Risk of fire and explosion 2.7 Emergency procedures and rescue ANNEX 1 -a - AUTHORIZATION FORM FOR ENTRY IN CONFINED SPACES IN THE EVENT OF EXPECTATION OF WORK TO CONTRACTORS OR SELF-EMPLOYED ANNEX 1 -b - AUTHORIZATION FORM FOR ENTRY IN CONFINED SPACES ANNEX 2 - ILLUSTRATIVE LIST OF POSSIBLE RISK FACTORS IN CONFINED SPACES ANNEX 3 - TECHNICAL ASPECTS TO KNOW / ASSESS THE START OF WORK ANNEX 4 - EXAMPLE OF A CHECKLIST ANNEX 5 - MAJOR LEGISLATIVE REFERENCES RELATING TO CONFINED SPACES OR SUSPECTED OF POLLUTION ANNEX 6 - TOXIC SUBSTANCES AND TYPE AND ACCIDENTS asphyxiating ANNEX 7 - Signage that you may want to put in confined spaces or suspected pollution

Appendix H.

French Regulations

#	Subject	Law	Link	Content (English)
1	Transport and storage of dangerous chemicals products (1c)	Cross reference to the main applicable legislations, namely: 1) Code de l'environnement : Articles L521-1, L521-6, L521-12 à L521-23, L541-7, L541-44 à L541-48 2) Code de la défense : Articles R2352-73 à R2352-80 3) Accord européen sur le transport international des marchandises dangereuses par route (ADR) en vigueur le 1er janvier 2011 4) Arrêté	http://vosdroits.service-public.fr/professionnels-entreprises/F23646.xhtml	This link details the rules and requirements (in French Language) which apply to the transport of dangerous materials. It is aimed mainly at the transporter, but highlight the role of other parties. It provides a link to the declaration to be submitted in case of accidents. Safety Adviser Companies that load, transport by land or discharge of hazardous materials must designate a security adviser, to assist in the prevention of risks in order to: • examine compliance with Transport Rules hazardous materials, • to advise the company in the transportation, • write a report accident and forward recommendations to the company, • to prepare an annual report on the activities of the company, including in particular the actions taken to improve safety. The accident report and the annual report must be kept for 5 years. The company must provide the identity of the counselor, who holds a qualification certificate (valid 5 years) by the declaration cerfa No. 12251. If the counselor cannot carry out its mission, the company is required to appoint a new representative within 2 months at the latest and indicate the change to the authorotities within 15 days. The absence of a counselor may be punished by one year imprisonment and a fine of EUR30,000.

#	Subject	Law	Link	Content (English)
		du 29 mai 2009 relatif aux transports de marchandises dangereuses par voies terrestres (dit « arrêté TMD ») 5) Circulaire du 19 novembre 2012 relative aux mesures de maîtrise des risques en matière de transport de matières dangereuses		

#	Subject	Law	Link	Content (English)
2	Fire Regulation applicable to facilities	Fire and workplace Prevention and Fire Fighting	Please see document "INRS - Incendie et lieu de travail (ed990)"	Section 1 (Regulation) of this document presents a comprehensive review of all applicable codes, norms and standards. Appendix 4 (Please see page 88). Summary tables of maintenance to be performed (The following tables are taken from the brochure INRS ED 828 Main verification periodicals.) Extinguishers a) Fire extinguishers subject to the order of 15 March 2000Checking the status of the device and security level control. 1. The periodicities are usually either recommended by installers or recommended by insurance companies' members of the Apsad or imposed by regulations. 2. When pressure equipment is monitored by a recognized inspection service, the nature and frequency of investigations under periodic requalification are defined in the inspection plans prepared in accordance with professional guides approved by the Minister for Industry. 3. Hydraulic test periodic requalification is to maintain the equipment at a pressure equal to its hydrostatic test pressure (PT) or initial test (PE). This pressure is maintained for the time required to complete examination of the outer walls of the pressure equipment. Hydraulic test is satisfactory if periodic requalification the pressure equipment has not been oozing, leak or rupture for the duration of the test and shows no significant permanent deformation. 4. This check is to ensure that the safety accessories are the original ones or they offer protection equipment suitable for the developed industrial processes. It is also an operating control or maneuverability test and verification of the absence of barriers, which may hinder their operation.

#	Subject	Law	Link	Content (English)
3	Drug and alcohol policy & Legal requirements	Multiple (see INRS document), in particular: Code du travail, Code Penal, Code de la Sante Publique, Code de la Route	See document "INRS - Pratiques addictives en milieu de travail (ed6147)"	(All references articles apply) INRS document "INRS - Pratiques addictives en milieu de travail (ed6147)" provides a summary of the regulatory regime applicable to employers and employees, including references to relevent articles within the "Code du Travail", "Code de la Route", "Code Penal", "Code de la Sante Publique".: Code du Travail : • Article R. 4228-20: No alcoholic beverages other than wine, beer, cider and perry is allowed in the workplace. • Article R. 4228-21: It is forbidden to leave to enter or remain in the workplace of people drunk. • Article R. 3231-16: It is forbidden to assign alcoholic beverages as benefits in kind. Penal Code: • Article 222-37 Prohibition of detention (transport, offer, sale , purchase or use illegal) drugs. Code of Public Health : • Article L. 3421-1 : General prohibition of consumption of drugs (cannabis, cocaine ...) . • Article R. 3511-1 : Ban on smoking in all enclosed and covered places which are workplaces. Accordance with the provisions of Articles R. 3511-2 to R. 3511-6 , confined spaces and ventilation can be made available to smokers. Code de la Route : • Article L. 235-1 : No driving a vehicle, or to accompany a learner driver , having used drugs . • Article R. 234-1 : Prohibition to drive transit with alcohol level greater than or equal to 0.2 g per liter; for other categories of vehicles, alcohol should not be less than 0.5 g per liter. • Article R. 234-6 : Every driver of a mandatorily equipped with an alcohol interlock vehicle must use this device prior to starting the vehicle. • Article R. 234-7 : Every driver of a land motor vehicle , except a moped, must have a breathalyzer , not used immediately available. This does not apply to vehicles with an alcohol interlock.

#	Subject	Law	Link	Content (English)
4	Regulation regarding medical investigations of the employees /Alcohol and drug test regulations	Code de la Sante Publique, Article L. 6211-1 (drugs)	See document "INRS - Pratiques addictives en milieu de travail (ed6147), Section "Testing""	(All references articles apply) Alcohol Testing Exhaled air is not considered a biological sample. The breathalyzer can be obtained by the employer. However, this control is only possible if it is provided in the company internal rules and procedures that its challenge is possible and defined, it is justified by the nature of the task and the intoxicated presents a danger for people and property (Court of Cassation, social Chamber, 24 February 2004, n ° 01-47000). Medical drug testing This screening is done by taking a biological sample (urine, saliva, blood ...). It is considered a medical test (Article L. 6211-1 Code of Public Health) and can only be done by a doctor. The latter informs the employee of the nature of the test whose result falls within the medical secret and is not sent to the employer.
5	Regulation regarding H&S incident reporting to authorities	Defined in Code de la Securite Sociale, Article L411-1.	http://vosdroits.service-public.fr/professionnels-entreprises/F24246.xhtml#Ref	(**All references articles apply**) **Defined in Article L411-1;**An accident at work, whatever the cause, the accident arising out of or in connection with work to any employee or working in any capacity or in any place whatsoever, for one or more employers or entrepreneurs. **Mandatory steps for employers** Once notified of the accident by the employee, the employer must give him the accident sheet work to allow it to support care. The employer must report the accident to the CPAM within 48 hours (except Sundays and holidays). In this statement, he may make reservations motivated the professional nature of the accident. (...) In the event of an accident to a temporary worker provided by a temporary work agency (or interim), the operator must notify within 24 hours by registered letter of Carsat prevention service, inspection labor and employment agency.

#	Subject	Law	Link	Content (English)
6	Working time restrictions (3)	Summary on working time regulation	http://travail-emploi.gouv.fr/informations-pratiques,89/les-fiches-pratiques-du-droit-du,91/duree-du-travail,129/la-duree-legale-du-travail,1013.html	The legal working: Fixed at 35 hours for all businesses regardless of their actual, legal actual working hours is a term of reference, a point at which overtime is calculated. There is neither a minimum (employees may be part-time employees) or a maximum: Additional hours may be completed in compliance with the maximum beyond which no work periods may be requested. In some sectors applies a so-called equivalence duration. Longer service work (e.g. 38 hours) is considered equivalent to the legal limit (35 hours). In this case, the calculation of overtime is triggered after the 38th hour of work and not the 35th hour. The actual working time In the calculation of the statutory working hours, the actual working time, that is to say, any period during which the employee is at the disposal of the employer, the obligation to comply with its directives without freely able to devote to personal matters. If they meet these criteria, the recovery time and breaks are considered as time worked. Unless otherwise provided in an agreement or agreement applicable to the company, not an actual working time devoted to the dressing and undressing. However, when wearing work attire is required by the regulations, the rules of the company, an agreement, a collective agreement or contract of employment of the employee, the time spent on it - if place in the enterprise or workplace - should be counterparties to employees. Time business trip to visit the place of performance of the contract of employment is not a actual working time. However, if it exceeds the normal travel time between home and the usual place of work , there must be a consideration either as rest or financial , as determined by agreement or collective agreement or failing by unilateral decision of the employer taken after consulting the works council or staff representatives , if they exist. The share of business travel time coinciding with the work schedule shall not result in loss of pay. Hours equivalence In certain professions (health, medical and social ...) , employees may be subject to working time - including idle time - exceeding the statutory working hours but assimilated thereto. For example, the weekly working time may be fixed taking into account the

#	Subject	Law	Link	Content (English)
				equivalence regime, 38 hours will be counted as 35 hours. Hours are remunerated in accordance with the equity method or extended agreements applicable to business uses. The equivalent period (e.g. 38 h) is the threshold for overtime. The penalties These are periods during which the employee, without the permanent and immediate disposal of the employer, has the obligation to remain at home or close to be able to intervene to perform work service the company. The penalties are established by collective agreement or agreement extended work or business or establishment, which sets the organization as well as financial compensation or in the form of rest to which they give rise user agreement. Failing conclusion of a convention or agreement , the conditions under which penalties are organized and financial compensation or rest which they give rise are determined by the employer after consultation and information of the works council or , in the absence of a works council, staff representatives if any, and after informing the inspector. The fine without any intervention is counted in the minimum periods of daily and weekly rest. However, the intervention periods constitute effective working time recorded as such in the working hours. Individual programming periods on call is notified to each employee concerned fifteen days in advance, except in exceptional circumstances and provided that the employee is notified at least one clear day in advance. The maximum working hours Unless authorized by the labor inspector, working hours of workers aged under 18 years cannot exceed the statutory working hours. However, there are maximum beyond which no actual work may be requested times. The maximum working time is also needed to the employee who has several jobs. Unless otherwise provided, the maximum periods shall be: 10 hours a day ; 48 hours per week ; 44 hours on average over a period of 12 consecutive weeks. In addition, employees must have a daily rest at least 11 hours and a weekly rest period of 24 hours plus the hours of daily rest .

#	Subject	Law	Link	Content (English)
				The employer is required to give at least a 20 minute break when the daily working time is 6 hours. The exceptions to the hours of work are granted by the labor inspector for nominations for the maximum daily by the Regional Director of companies, competition, consumption, labor and employment (Direccte) or, by delegation , the head of the territorial unit , or delegate, the labor inspector for nominations for the maximum weekly .
7	On-site Welfare Facilities - General Requirements	Code du Travail (multiples articles are concerned - see INRS guidance document below for full details of all relevent articles within Code du Travail)	http://www.legifrance.gouv.fr/affichCode.do?idArticle=LEGIARTI000006903194&idSectionTA=LEGISCTA000006178077&cidTexte=LEGITEXT000006072050&dateTexte=20131220	Code du Travail Article L4211-1 The owner undertaking the construction or alteration of buildings for receiving workers comply with the legal provisions to protect their health and safety. Article L4211-2 For the purposes of the provisions relating to the design of workplaces, Orders in Council of State, made under article L. 4111-6 determine: 1 The rules of health and safety which comply with the contractors during the construction or alteration of buildings for receiving workers; 2 Local and devices or arrangements of any kind that are equipped buildings mean that these decrees to improve the health and safety of workers engaged in construction or maintenance. These decrees are taken after consultation with the professional organizations of employers and workers concerned.

#	Subject	Law	Link	Content (English)
8	Danger Zones - Requirements for on-site welfare facilities	INRS Guidance Document	http://www.legifrance.gouv.fr/affichCode.do?idArticle=LEGIARTI000006903194&idSectionTA=LEGISCTA000006178077&cidTexte=LEGITEXT000006072050&dateTexte=20131220	This brochure contains the laws and regulations applicable in the design or layout of workplaces. This document should be a tool for different actors (project owners, architects, consultants, entrepreneurs) who undertake the construction or development of workplaces. They find meeting all regulatory requirements to be met by commercial buildings: the installation rules, traffic control against fire, air and space heating, lighting, social spaces.. . This brochure usefully complements the document INRS ED 950 "design places and situations of Occupational Health and Safety. Approach, methods and technical knowledge." Section 2.2.3 addresses (please see page 28) requirements for "Danger Zones" where the nature of work such as building a wind farm presents risk to public. Art. R. 4214-14: Where the nature of the proposed activities may lead to the area of working at danger zones that could not be avoided, these areas are marked to visibly and materialized by devices intended to prevent unauthorized entry. (...) Art. R. 4224-20: When not possible, given the nature of the work, avoid areas including hazard with risk of falls of persons or risk of falling objects, and even if it is specific activities of maintenance or repair are indicated visibly in these areas. They are also materialized by devices intended to prevent unauthorized workers entering these areas. (....) Art. R. 4215-1: The client ensures that electrical installations are designed and manufactured to prevent the risk of electric shock by direct or indirect contact, or burning and fire or explosion hazards of electrical origin. Art. R. 235-3-5 [now R. 4215-1]-Circular of 14 April 1995: It is important that the project owner is subject to the provisions of Decree No. 88-1056 November 14, 1988 [modified] because, in general, it is responsible for part of the plant delivered to the user premises. Some provisions, such as in particular those relating to the grounding of the masses, cannot be easily observed at the time of making the foundations. The owner must ensure that it is always

#	Subject	Law	Link	Content (English)
				possible to complete the electrical installation respecting the regulations. Decree of 4 August 1992 (OG 12-08-92) Article 1: During the construction of new buildings (incl. wind farms) or extension of existing buildings (or wind farms), intended to shelter workplaces, the client must perform earth ground the masses by a foundation ditch loop or an equivalent provision, as the use of common-ground connections constituted in particular by metal poles the exterior walls of buildings with metal frameworks. 2.6.2. Design and implementation of electrical installations Art. R. 4215-3 The facilities are designed and constructed so that: 1. No dangerous live parts are not accessible to workers, except premises or places with special risk of electric shock, which are subject to specific requirements laid down in Articles R. 4226-9, R. 4226-10 and R. 4226-11; 2. In the event of an insulation fault, no mass present, with another mass or a conductive element, a difference of potential danger to the workers.2.6.2. Design and implementation of electrical installations Art. R. 4215-3 The facilities are designed and constructed so that: 1. No dangerous live parts are not accessible to workers, except premises or places with special risk of electric shock, which are subject to specific requirements laid down in Articles R. 4226-9, R. 4226-10 and R. 4226-11; 2. In the event of an insulation fault, no mass present, with another mass or a conductive element, a difference of potential danger to the workers. Art. R. 4226-9 Rooms or areas reserved for the production, conversion and distribution electricity are considered of particular risk shock electric, whatever the pressure, when the protection against direct contact is provided by obstacles or distance or in low voltage, where protection against direct contact is not required. These premises or locations are marked visible and materialized with devices to prevent access by unauthorized persons. The access doors to these rooms or areas should be closed and equipped with a locking system that can be freely opened from the inside. The rules for access to the premises or locations are specified in Article R. 4544-6. (...) Art. R. 4215-13: Local or hotspot in the production, conversion or

#	Subject	Law	Link	Content (English)
				distribution electricity, local called or electrical service locations are designed and made so as to ensure at the same time: 1. The availability of materials and ease of movement and movement; 2. Protection against electric shock; 3. Risk prevention of burns and fire; 4. Risk prevention of occurrence of toxic or asphyxiating atmosphere caused by the emission of gases or vapors in an operating incident electrical equipment; 5. Security lighting.
9	Electrical Installations - requirements for on-site welfare facilities	INRS Guidance Document	http://www.legifrance.gouv.fr/affichCode.do?idArticle=LEGIARTI000006903194&idSectionTA=LEGISCTA000006178077&cidTexte=LEGITEXT000006072050&dateTexte=20131220	Art. R. 4215-1: The client ensures that electrical installations are designed and manufactured to prevent the risk of electric shock by direct or indirect contact, or burning and fire or explosion hazards of electrical origin. Art. R. 235-3-5 [now R. 4215-1]-Circular of 14 April 1995: It is important that the project owner is subject to the provisions of Decree No. 88-1056 November 14, 1988 [modified] because, in general, it is responsible for part of the plant delivered to the user premises. Some provisions, such as in particular those relating to the grounding of the masses, cannot be easily observed at the time of making the foundations. The owner must ensure that it is always possible to complete the electrical installation respecting the regulations. Decree of 4 August 1992 (OG 12-08-92) Article 1: During the construction of new buildings (incl. wind farms) or extension of existing buildings (or wind farms), intended to shelter workplaces, the client must perform earth ground the masses by a foundation ditch loop or an equivalent provision, as the use of common-ground connections constituted in particular by metal poles the exterior walls of buildings with metal frameworks. 2.6.2. Design and implementation of electrical installations Art. R. 4215-3 The facilities are designed and constructed so that: 1. No dangerous live parts are not accessible to workers, except premises

#	Subject	Law	Link	Content (English)
				or places with special risk of electric shock, which are subject to specific requirements laid down in Articles R. 4226-9, R. 4226-10 and R. 4226-11; 2. In the event of an insulation fault, no mass present, with another mass or a conductive element, a difference of potential danger to the workers.2.6.2. Design and implementation of electrical installations Art. R. 4215-3 The facilities are designed and constructed so that: 1. No dangerous live parts are not accessible to workers, except premises or places with special risk of electric shock, which are subject to specific requirements laid down in Articles R. 4226-9, R. 4226-10 and R. 4226-11; 2. In the event of an insulation fault, no mass present, with another mass or a conductive element, a difference of potential danger to the workers. Art. R. 4226-9 Rooms or areas reserved for the production, conversion and distribution electricity are considered of particular risk shock electric, whatever the pressure, when the protection against direct contact is provided by obstacles or distance or in low voltage, where protection against direct contact is not required. These premises or locations are marked visible and materialized with devices to prevent access by unauthorized persons. The access doors to these rooms or areas should be closed and equipped with a locking system that can be freely opened from the inside. The rules for access to the premises or locations are specified in Article R. 4544-6. (...) Art. R. 4215-13: Local or hotspot in the production, conversion or distribution electricity, local called or electrical service locations are designed and made so as to ensure at the same time: 1. The availability of materials and ease of movement and movement; 2. Protection against electric shock; 3. Risk prevention of burns and fire; 4. Risk prevention of occurrence of toxic or asphyxiating atmosphere caused by the emission of gases or vapors in an operating incident electrical equipment; 5. Security lighting.

#	Subject	Law	Link	Content (English)
10	Storage and handling of flammable materials - equirements for on-site welfare facilities	INRS Guidance Document	http://www.legifrance.gouv.fr/affichCode.do?idArticle=LEGIARTI000006903194&idSectionTA=LEGISCTA000006178077&cidTexte=LEGITEXT000006072050&dateTexte=20131220	Art. R. 4216-22: Premises or locations in which to be stored or manipulated classified substances or preparations explosive, oxidizing or extremely flammable and materials in a physical state which may give rise to risk of explosion or flash fire, have a breakdown suitable permanent. Art. R. 4216-23: The premises mentioned in Article R. 4216-22, as well as those in which are stored or manipulated substances or preparations classified easily flammable materials or in a physical condition such that they are likely to instantly ignite on contact with a flame or spark and spread quickly the fire, are designed and constructed so that: 1. No normal working position can be more than ten meters from the exit; 2. The doors of the premises open to the outside; 3. If windows of the premises are provided with grids or grilles, these open very easily from the inside.
11	Prevention of Fire & Fire Fighting - equirements for on-site welfare facilities	INRS Guidance Document	http://www.legifrance.gouv.fr/affichCode.do?idArticle=LEGIARTI000006903194&idSectionTA=LEGISCTA000006178077&cidTexte=LEGITEXT000006072050&dateTexte=20131220	Art. R. 4227-28: The employer shall take measures to ensure that any outbreak of fire can be quickly and effectively fought in the interest of the rescue workers. Art. R. 4227-29: First aid against fire is provided by a sufficient number of fire extinguishers and maintained in good condition. There should at least one portable fire extinguisher water spray with a minimum capacity of 6 liters per 200 square meters of floor. It should be at least one unit per level. When there is local special fire hazards present, including electrical hazards, they should be equipped with fire extinguishers, the number and type appropriate to the risks. Art. R. 4227-30: If necessary, the facility is equipped with fire hose, columns dry, wet columns, fixed installations automatic fire extinguishing or automatic fire detection installations. (...) Art. R. 4227-39: Fire safety instruction provides testing and periodic inspections of equipment and the years in which workers learn to recognize characteristics of the sound signal general alarm, locate

#	Subject	Law	Link	Content (English)
				and use spaces of secure waiting areas or equivalent, to use the first means relief and perform the various necessary maneuvers. These exercises and periodic tests are to be held at least every six months. Date and observations which they may have given rise are recorded in a register made available to the Labor Inspectorate. (...) Art. R. 4227-40: Fire safety instruction is communicated to the Labor Inspectorate.
12	Explosion Prevention - equirements for on-site welfare facilities	INRS Guidance Document	http://www.legifrance.gouv.fr/affichCode.do?idArticle=LEGIARTI000006903194&idSectionTA=LEGISCTA000006178077&cidTexte=LEGITEXT000006072050&dateTexte=20131220	Art. R. 4227-44: To ensure explosion prevention and protection against them, the employer is to take appropriate technical and organizational measure, the type of operation based on the principles of prevention and in the following order of priority: 1. Prevent the formation of explosive atmospheres; 2. If the nature of the activity does not prevent the formation of explosive atmospheres, avoid inflammation; 3. Reduce the harmful effects of an explosion to the health and safety of workers. Art. R. 4227-45: The measures taken by the employer, if necessary, combined and complemented with measures to prevent the spread of explosions. They are subject to periodic review and whenever occur significant changes in the conditions of execution of work. Art. R. 4227-46: The employer shall evaluate the risks created or may be created by explosive atmospheres taking into account at least: 1. of the likelihood that explosive atmospheres may arise and persist; 2. of the likelihood that ignition sources, including landfills electrostatic, can present themselves and become active and effective; 3. facilities, substances and preparations used, processes, and their possible interactions; 4. mrom the scale of the anticipated consequences of an explosion. (...) Art. R. 4227-49: Where explosive atmospheres may arise in such quantities as present a risk to the health and safety of workers or others, the employer shall take the necessary measures to ensure that:

#	Subject	Law	Link	Content (English)
				1. The workplace allows work safely; 2. Adequate supervision is ensured and appropriate technical means are used; 3. A worker training on protection against explosions or issued; 4. The workers are equipped, as necessary, work wear suitable against the risk of inflammation. Art. R. 4227-47: Risk assessment of explosion is comprehensive and, if necessary, combined with results of the assessment of other risks identified in each work unit the company or institution. Art. R. 4227-52: The employer shall establish and maintain a document relating to the protection against explosions, integrated in one document risk assessment. This document contains information relating to compliance with the obligations Articles R. 4227-44 to R. 4227-48 include: 1. The identification and assessment of explosion risks; 2. The nature of the measures taken to ensure compliance with the objectives defined in this section; 3. The classification zones at locations where atmospheres explosive may occur; 4.The locations to which the minimum requirements laid down by Article R. 4227-50; 5. The terms and rules under which workplace and work equipment, including warning devices, are designed, operated and maintained to ensure security; 6. If necessary, the list of work to be done according to the instructions written by the employer or whose execution is subject to the grant of an authorized by the employer or by a person authorized by him for this purpose; 7. The nature of the arrangements for the use of work equipment is safe, according to the provisions of Book III.

#	Subject	Law	Link	Content (English)
13	Regulations covering Tools (Calibrated Tools, High Torque Devices etc.)	Labor Code (Code du Travail)	http://www.legifrance.gouv.fr/affichCode.do?idArticle=LEGIARTI000006903209&idSectionTA=LEGISCTA000006189725&cidTexte=LEGITEXT000006072050&dateTexte=20131220	(All references articles apply) All work equipment (machines, equipment, tools, machinery, equipment and installations) that have not been subject to specific orders are subject to the obligations set out in Article L. 4321-1 of the Labour Code, and in particular those relating to the maintenance state. *** Article L4321 -1 Work equipment and means of protection placed in service or used in schools to receive workers are equipped, installed, operated , adjusted and maintained to protect the health and safety of workers , including in case of change of work equipment and the means of protection . Article L4321 -2. It is forbidden to use or use of work equipment and means of protection that does not meet the technical requirements of Chapter II design and certification procedures of Chapter III of Title I. Article L4321 -3 Notwithstanding the provisions of Article L. 4321-2 , is permitted only for purposes of demonstration , the use of work equipment does not meet the new provisions of Article L. 4311-1. The measures necessary to avoid any harm to the safety and health of workers involved in the demonstration and those at risk resulting are then implemented. In this case , a warning whose characteristics are determined by joint order of the Minister of Labor and Minister of Agriculture is placed close to the work equipment subject to the demonstration, for the duration of thereof.
14	Inspection Requirements	Labor Code (Code du Travail)	http://www.legifrance.gouv.fr/affichCode.do?idArticle=LEGIARTI000006903209&idSection	PART VIII: MONITORING THE APPLICATION OF LABOUR LEGISLATION BOOK I: LABOUR INSPECTION. TITLE I: SKILLS AND MEANS OF INTERVENTION Chapter I: Distribution of responsibilities among the various government departments. This chapter does not include laws Chapter II: Servants of Competence Section 1: Labor inspectors. (Articles L8112-1 to L8112-4) Section 2: Labor Controllers. (Article L8112-5)

#	Subject	Law	Link	Content (English)
			TA=LEGISCTA000006189725&cidTexte=LEGITEXT000006072050&dateTexte=20131220	Chapter III: Powers and means of intervention Section 1: Admission in schools. (Articles L8113-1 to L8113-2)
15	Procedures to follow in case of Incident or Accident	Code de l'environnement – Articles L 125-2, L 512-7, L 512-12, L 514-1 to L 514-18, R512-31, R512-69, R512-70, R514-4	http://www.installationsclassees.developpement-durable.gouv.fr/Incidents-Accidents.html	For ICPE in General, all the following articles apply (Code de l'environnement – Articles L 125-2, L 512-7, L 512-12, L 514-1 à L 514-18, Articles R512-31, R512-69, R512-70, R514-4 du code de l'environnement). In practice however, new wind farms are acknowledged as less dangerous than most ICPE installations and proportionality rules are suggested (see document "ICPE 5", section related to Risk study (etude de danger). The Reporting obligation The operator must report accidents and incidents after a timely inspection at classified installations. Role of the operator in case of incident or accident Incident or accident, the operator shall, under the supervision of the administration to implement the appropriate measures. The means and the corresponding provisions are described in the risk assessment and the establishment of POI, if applicable. The operator shall keep the government informed on implementation of mitigation measures and appropriate intervention coordination with emergency services and shall provide useful information to the absorption of the incident, then it adopt preventive measures in order to reduce the likelihood of reoccurrence and severity of this type of event. The operator shall submit an accident report and an incident report to the inspector of classified installations. Role of inspection incident or accident Inspector will survey to monitor the implementation of the

#	Subject	Law	Link	Content (English)
				regulation, if he/she finds possible violations and he/she will forward the findings to the prosecutor with the necessary background, if appropriate, will propose to the procedure appropriate sanction, will assess the adequacy of requirements already imposed on the operator having regard to developments, if appropriate, will propose what is needed for urgent requirements appropriate to the situation. Restarting works after accident The return to service after an incident or accident may be subject to obtaining a new prefectural authorization .
16	Decommissioning	Code de l'Environnement, Partie législative, Livre V (Prévention des pollutions, des risques et des nuisances), Titre V (Dispositions particulières à certains ouvrages ou installations), Chapitre III (Eoliennes), Article L553-3	http://www.legifrance.gouv.fr/affichCode.do;jsessionid=4E54C80F614AC714D8104BFB7D051D4A.tpdjo01v_1?idSectionTA=LEGISCTA000006159294&cidTexte=LEGITEXT000006074220&dateTexte=20131206	Article L553-1 (Edited by ION 2013-619 of 16 July 2013 - art. 38 (V)): Terrestrial facilities producing electricity using the mechanical energy of the wind, the height of the mast exceeds 50 meters are subject to authorization under Article L. 511-2, within one year from the date of publication of the law n ° 2010-788 of 12 July 2010 cited above. The issuance of the license to operate is subject to the remoteness of plants with a distance of 500 feet from the Dwelling buildings, manned buildings and areas for housing defined in the documents planning in effect on the date of publication of the Act. The operating license reflects the favorable parts of the regional territory development of wind power defined by the regional wind power scheme referred to in 3 of I of Article L. 222-1, if this pattern exists.

#	Subject	Law	Link	Content (English)
17	Marking & Beaconing : requirements at installation and during operation.	Arrêté du 13 novembre 2009 relatif à la réalisation du balisage des éoliennes situées en dehors des zones grevées de servitudes aéronautiques	http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000021491130	This regulation outlines the requirements for marking the WTGs, which is subject to inspections and audits in operational phase. The marking requirements have bearing on safety and environmental (visual) impact of WTGs. Article 1: This decree fixes (see annexes) the requirements regarding the realization of markings on wind turbines which constitute an obstacle to air navigation and whose marking is prescribed under Article R. 244-1 of the Code of Civil Aviation and Article 2 of the Decree of 25 July 1990 referred to above. The total height of the obstacle to be considered is the maximum height of the wind turbine, that is to say with a blade in a vertical position above the nacelle. 1. General: A wind turbine typically includes a tower or a drum on which nacelle is installed containing the electrical generators and supports the rotating blades. 2. Color of wind turbines 2.1. General: The color of wind turbines is defined in terms of quantity and color of the luminance factor. 2.2. Colorimetric Quantities: The colorimetric quantities are limited to the white area as defined in the Appendix to this Annex. 2.3. Luminance factor: The luminance factor is greater than or equal to 0.4. (...) 3. Lighting Equipment 3.1. General: All wind turbines are equipped with obstruction lighting. Obstacle lighting fires are the subject of a type of certificate of conformity issued by the Civil Aviation Technical Service of the Directorate General of Civil Aviation (STAC), depending on the relevant technical specifications. Detailed specifications and the certification process are available on the STAC website (http://www.stac.aviation-civile.gouv.fr). The power supply serving

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				the lighting must be recovered by means of an automatic device and switch in a time not exceeding 15 seconds. The energy source for the emergency supply of lighting facilities must have a range of at least 12 hours unless specific operating procedures are implemented that reduce this minimum autonomy. The markup is monitored by the operator (remote monitoring and specific operating procedures). It signals as soon as possible any failure or disruption of the markup to the authority of the territorially competent civil aviation. 3.2. Lighting Day: Each turbine has a lighting day provided by medium obstruction light intensity type A (white strobe lights 20 000 cd [cd]). These obstruction lights are installed on top of the nacelle and must ensure the visibility of wind from all directions (360 °). 3.3. Night Lighting: Each turbine has a night lighting provided by medium-intensity obstacle lights, Type B (red flashing lights of 2000 cd). These obstruction lights are installed on top of the nacelle and must ensure the visibility of wind from all directions (360 °). 3.4. Passage of the light of day lighting at night marking.The day is characterized by a higher background luminance of 500 cd / m², dusk is characterized by a background luminance between 50 cd / m² and 500 cd / m², and the night is characterized by a background luminance below 50 cd / m². The active markup when dusk is the day marking the night lighting is activated when the bottom of the luminance below 50 cd / m². 3.5. Markup of tall wind turbines: In the case of a wind turbine high total height of 150 m, the markup by medium intensity described above is complemented by low-intensity obstacle lights type B (fixed red 32 cd) installed on the barrel. They must ensure the visibility of wind from all directions (360 °). 3.6. Lighting of Wind Farms: A wind farm is a set of two wind turbines installed by the same operator. In a wind farm, the following were adopted: - The provisions of 3.1 to 3.5 apply to all wind field; - Bursts of lights of all machines are synchronized, day or night. 4. Wind turbines at sea and coastal: The markup coastal or offshore

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				wind turbines installed should not interfere with maritime markup. If risk of interference, the markup of these turbines will be defined as part of a study by the territorially competent services in collaboration with the technical department of civil aviation. (....) A.1.3. Practical Arrangements: From a practical point of view of industrial application, it is possible to approach the RAL references (from RAL color standard, German Institute for Quality Assurance and Labeling). The main references RAL be used by wind turbine manufacturers are: - Shades RAL 9003, 9010, 9016 which are located in the white area and have a higher luminance factor or equal to 0.75; - The shade RAL 7035, which is in the white area and has a luminance factor greater than or equal to 0.5 but strictly less than 0.75; - The shade RAL 7038 which is within the area of white and has a luminance factor greater or equal to 0.4 but strictly less than 0.5.
18	WTG Design Safety	EU: Directive Machine (2006/42/EC). France: Transposition complète par le décret n° 2008-1156 du 7 novembre 2008 relatif aux équipements de travail et aux équipements de	http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000019736204&dateTexte=	Applies mainly to manufacturers of WTGs at design stage. Wind farm owners are to ensure that requirements are maintained during the operational phase. Manufacturers are required to certify the conformity of their machinery with the essential safety requirements set by various legislative and regulatory provisions: Directive No. 98/37/EC "machines" which presents an appropriate framework for the design and operation of wind turbines. This directive was transposed into French law in particular Articles L. 233-5 and R. 233-83 of the Labour Code. Manufacturers must produce, at the request control services technical documentation proving compliance. Technical rules on health and safety. General principles. 1. The manufacturer of machinery must ensure that a risk assessment is conducted to determine the technical rules that apply to the machine. The machine is then designed and constructed taking into account the results of the risk assessment. By the iterative process of assessment and risk reduction referred to above, the manufacturer: - Determine the limits of the machine, include the intended use and any reasonably foreseeable misuse;

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		protection individuelle.		- Identify the hazards that may result from the machine and the associated hazardous situations; - Estimate the risks, taking into account the severity of the possible injury or damage to health and probability; - Evaluate the risks, with a view to determining whether risk reduction is required, in accordance with the objective of this Directive; - Eliminate the hazards or reduce the risks associated with these hazards by application of protective measures, according to the priorities established in paragraph 1.1.2 b. 2. The obligations under the technical rules only apply when the corresponding hazard exists for the machinery in question when used as provided by the manufacturer but also in foreseeable abnormal situations. In any case, the safety integration principles of paragraph 1.1.2 and the obligations concerning marking of machinery and instructions referred to in paragraphs 1.7.3 and 1.7.4 apply. 3. The technical rules set out in this Annex are required. However, given the state of the art, the objectives which they lay down may not be achieved. In this case, the machine is, as far as possible, designed and built to work towards these goals. (...) 5° Les équipements visés par les dispositions de l'annexe I, issue de la transposition de la directive 98/37/CE modifiée, conçus et construits conformément aux dispositions de cette annexe, maintenus en conformité avec ces dispositions et mis sur le marché avant le 29 décembre 2009, sont considérés comme conformes aux dispositions de la présente annexe. (....) 1.3. Protection against mechanical risks. 1.3.1. Risk of loss of stability: The machine and its components and fittings are designed and constructed to be stable enough to avoid overturning, falling or uncontrolled movements during transportation, assembly, dismantling and any other action involving the machinery. If the shape of the machine or its intended installation does not ensure sufficient stability, appropriate fastening means are provided and indicated in the instructions. 1.3.2. Risk of break in service: 1 The different parts of the machine and the connections between them are designed and built to withstand the stresses to which they are subjected during use. The materials used have a sufficient strength, adapted to the

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				characteristics of the work environment provided by the manufacturer, in particular as regards the phenomena of fatigue, aging, corrosion and abrasion. The instructions indicate the type and frequency of inspections and maintenance required for safety reasons. It states, if any, parts subject to wear and the criteria for replacement.
19	Design, Inspection and maintenance requirements for electrical components and installations	Décret n°88-1056 du 14 novembre 1988, relatif au contrôle des installations électriques	http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000000866441&fastPos=1&fastReqId=1299124638&categorieLien=cid&oldAction=rechTexte	Decree No. 88-1056 of 14 November 1988 taken for the implementation of the provisions of Book II of the Labour Code (Title III: Health, safety and working conditions) regarding the protection of workers in establishments that involve electrical currents. Content (Section I: General, Section II: Conditions to be met by facilities; Section III: Protection of workers against the risk of contact with live conductors or conductive parts usually energized (direct contact) Section IV: Privacy workers against the risk of contact with the masses being accidentally turned on (indirect contact) Section V: Prevention of burns, fires and explosions of electrical origin; Section VI: Use, monitoring, maintenance and verification of electrical installations; Section VII: various measures Article 53 I. - Notwithstanding the requirements of Article 47, the facilities, regardless of the area must be checked during commissioning or after undergoing a fundamental change, and periodically thereafter. These checks are subject to detailed reports including specific finding clearly points where facility deviate from the provisions of this decree and orders made thereunder. II. - The frequency, purpose and the scope of audits and the content of the corresponding reports are fixed by decree. III. - Checks carried out during the commissioning of the facility or after a change in structure are performed by a person or an authorized body, chosen by the head teacher on a list established by order. However, these checks can be done by people inside and outside the facility including the list of names to be disclosed by the head of establishment to the Regional Director of Labour and Employment or the head of the regional inspectorate Labour, Employment and agricultural social Policy. These people must have extensive

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				knowledge in the field of prevention of electrical hazards and regulatory provisions related thereto and exercising regularly audit activity. IV. - The head of establishment should carry out periodic checks by persons within or outside the institution and with extensive knowledge in the field of prevention of risks from electricity and regulations relating thereto. Article 57 In the event of major technical difficulties, generality of derogations from certain provisions of this decree may be granted by decree. For the same reasons, the Regional Director of Labour and Employment or the head of the regional department of labor inspection, employment and agricultural social policy may by decision after consulting the health committee , safety and working conditions or, in his absence, staff representatives, grant a headteacher for derogations from certain provisions of this Decree. These orders and decisions set compensatory security measures to which the exemptions are subject and the period for which they are granted.
20	Inspection and maintenance of WTG service vans	Code de la Route	http://www.legifrance.gouv.fr/affichCodeArticle.do?idArticle=LEGIARTI000006841815&cidTexte=LEGITEXT000006074228&dateTexte=20131219&oldAction=rechCodeArticle	Periodic technical inspection of light vehicles in France is mandatory since 1 January 1992. It is regulated by the Code de la Route (R.323-1 to R.323-26) and the "arrete" of June 18, 1991, as amended by successive "arrete". According to Article 311.1 of the Code de la Route, are affected by the mandatory periodic inspection the vehicles of categories M1 and N1 (motor vehicles having at least four wheels, weight lower or equal to 3.5 tonnes) and constructed for the transport of persons (M1) or goods (N1). All above mentioned articles apply

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21	Manual handling (1)	INRS - Manutention manuelle - Aide-mémoire juridique (tj18)	See document "INRS - Manutention manuelle - Aide-mémoire juridique (tj18)"	This document is a summary of the laws and regulations relating to manual handling. After a brief review of the history of the regulation, the checklist includes the following topics: - Measures concerning the organization of work, risk assessment, limiting the use of manual handling, limitation of port charges, personal protection; - Training and information of workers; - The role of the occupational physician; - Occupational diseases.
22	Manual handling (2)	Code du Travail, Articles R4541-1 to R4541-11	http://www.legifrance.gouv.fr/affichCodeArticle.do?idArticle=LEGIARTI000020398152&cidTexte=LEGITEXT000006072050&dateTexte=20131219&oldAction=rechCodeArticle	All referenced articles apply. Measures include avoiding manual handling, using mechanical aids. Regulation highlights training requirements, role of the occupational physician. Article R4541-1 Modified by Decree No. 2009-289 of 13 March 2009 - s. 4 The provisions of this chapter apply to all manual handling say there is a risk particularly of back injury to workers due to the load characteristics or unfavorable ergonomic conditions. Article R4541-2 Created by Decree No. 2008-244 of 7 March 2008 - s. (V) By manual handling means, any transporting or supporting of a load, including lifting, putting down, pushing, pulling, carrying or moving, that requires physical effort of one or more workers.

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23	Noise regulation	Articles R. 1334-30 à 37 du code de la santé publique	http://www.legifrance.gouv.fr/affichCode.do;jsessionid=AF243DEB95DBB107D4C91CBFB4463D48.tpdjo05v_3?idSectionTA=LEGISCTA000006190341&cidTexte=LEGITEXT000006072665&dateTexte=20091231	Article R1334 -30 Learn more about this article ... Created by Decree No. 2006-1099 of August 31, 2006 - art . 1 Official Journal September 1, 2006 The provisions of Articles R. 1334-31 to R. 1334-37 apply to all neighborhood noise except those from transport infrastructure and vehicles on those roads, aircraft, special activities and facilities of national defense, basic nuclear installations , installations classified for environmental protection as well as works of public and private networks, transmission and distribution of electric energy subject to the regulations under section 19 of the Act of 15 June 1906 on distributions energy. When they come from their own business or their own facilities, are also excluded , the sounds inside the mines , quarries, their dependencies and institutions mentioned in Article L. 231-1 of the Labour Code . Article R1334 -31 Learn more about this article ... Created by Decree No. 2006-1099 of August 31, 2006 - art . 1 Official Journal September 1, 2006 No particular noise should not by its duration, repetition or intensity, affect the tranquility of the neighborhood or to the health of man, in a public or private place , a person is itself the origin or whether through a person, a thing she has custody or animal under his responsibility. Article R1334 -32 Learn more about this article ... Created by Decree No. 2006-1099 of August 31, 2006 - art . 1 Official Journal September 1, 2006 When the noise referred to in Article R. 1334-1331 originated in a business other than one of those mentioned in Article R. 1334-1336 or sports , cultural or recreational organized habitually or subject to authorization, and whose conditions relating to noise have not been established by competent authorities , the disturbance of the peace

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				of neighborhood or human health is characterized if the global emergence of the noise perceived by others, as defined in Article R. 1334 to 1333 , exceeding the limit values laid down in that Article. When the noise mentioned in the preceding paragraph, seen inside the main parts of any housing accommodation, open or closed windows, is generated by equipment of professional activities , achievement is also characterized if the emergence spectral noise , as defined in Article R. 1334 to 1334 , exceeding the limit values laid down in the same article (1) . However , the overall appearance and , where applicable , are the emergence spectral locations when the measured ambient noise level , including the specific noise , is greater than 25 decibels , if the measurement is carried out inside the parts a main housing housing , open or closed , or 30 dB (a) in other cases windows . NOTE: (1) Decree 2006-1099 of 31 August 2006 art . 4: The second paragraph of Article R1334 -32 come into force from 1 July 2007. Article R1334 -33 Learn more about this article ... Created by Decree No. 2006-1099 of August 31, 2006 - art . 1 Official Journal September 1, 2006 The global emergence in a given location is defined by the difference between the ambient noise level , including the specific noise in question, and the level of residual noise made by all the usual , exterior and interior noise , corresponding to the normal occupancy and normal operation of the equipment, particularly in the absence of noise involved Limits the emergence values are 5 dBA during the daytime (from 7:00 to 10:00 p.m.) and 3 dB (A) at night (from 10:00 p.m. to 7:00) values plus a corrective term in dB (A) depending on the cumulative time of occurrence of particular noise: 1 Six for a period less than or equal to 1 minute, the measurement time of the ambient noise level is extended to 10 seconds when the

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				cumulative occurrence of particular noise lasting less than 10 seconds; Five- 2 for a period greater than 1 minute and less than or equal to 5 minutes; Four 3 ° for a period greater than 5 minutes and less than or equal to 20 minutes; Three 4 ° for a period exceeding 20 minutes and up to two hours; Two 5 ° for a period greater than 2 hours and less than or equal to 4 hours; 6 A for longer than 4 hours and less than or equal to 8 hours ; Zero 7 ° for a period exceeding 8 hours . Article R1334 -34 Learn more about this article ... Created by Decree No. 2006-1099 of August 31, 2006 - art . 1 Official Journal September 1, 2006 The spectral appearance is defined by the difference between the ambient noise level in a standard octave band, including the specific noise in question, and the level of residual noise in the same octave band , consisting of all usual noises , external and internal , corresponding to the normal occupancy of the premises mentioned in the second paragraph of Article R. 1334-1332 , especially in the absence of noise in question . The limits of spectral emergence values are 7 dB in the standard octave band centered on 125 Hz and 250 Hz and 5 dB in the standard octave band centered on 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz Article R1334 -35 Learn more about this article ... Created by Decree No. 2006-1099 of August 31, 2006 - art . 1 Official Journal September 1, 2006

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				Noise measurements referred to in Article R. 1334-1332 are performed according to procedures laid down by order of the ministers of health , ecology and housing. Article R1334 -36 Learn more about this article ... Created by Decree No. 2006-1099 of August 31, 2006 - art . 1 Official Journal September 1, 2006 If the noise referred to in Article R. 1334 to 1331 was caused by a construction of public or private works or works interesting buildings and equipment subject to proceedings for a declaration or authorization, affect the tranquility of the neighborhood or human health is characterized by one of the following circumstances : 1 The non- compliance with the conditions laid down by the competent authorities with regard to either the completion of the work or the use or operation of materials or equipment ; 2 The lack of appropriate precautions to minimize noise; 3 An unusually noisy behavior. Article R1334 -37 Learn more about this article ... Created by Decree No. 2006-1099 of August 31, 2006 - art . 1 Official Journal September 1, 2006 When she found non-compliance with the provisions of Articles R. 1334-32 to R. 1334-1336 , the competent administrative authority may take one or more of the measures provided for in Article II of L. 571-17 of the Environmental Code , in the circumstances specified in II and III of this article.
24	Soil and groundwater protection regulation	Code de l'Environnement, Partie législative, Livre V :	http://www.legifrance.gouv.fr/affichCode.do;jsessionid=42	This law requires individuals and asset owners to take responsibility for risk prevention and give rights to the state to carry out inspections when and where required.

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		Prévention des pollutions, des risques et des nuisances	E4C3520B804475AC182FDAA1A08A6D.tpdjo17v_1?idSectionTA=LEGISCTA000006129026&cidTexte=LEGITEXT000006074220&dateTexte=20131219	
25	Work Permit & Training Requirement - Electrical Work (1)	INRS Guidance article	http://www.inrs.fr/accueil/risques/phenomene-physique/electricite/habilitation.html	To intervene on or near an electrical installation, it is mandatory to have an authorization issued by the employer. This work permit is the recognition of a qualification. It reflects the ability of a person to perform operations safely and their knowledge of what to do in case of an accident. Before being authorized, the employee must be trained and have been declared fit. (see link for full details). See also INRS document "INRS - L'habilitation électrique - (ed6127)", and "INRS - Risque électrique. Avoir prise sur la prévention (TS728page24)"
26	Work Permit & Training Requirement - Electrical Work (2)	Code du travail (articles R. 4544-9 à R. 4544-11)	http://www.legifrance.gouv.fr/affichCodeArticle.do?idArticle=LEGIARTI000022849102&cidTexte=LEGITEXT000006072050	Operations on electrical installations or in their neighborhood can only be performed by qualified workers and it may be subject to assessment.

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27	Work Permit & Training Requirement - Electrical Work (3)	Technical Rules describes within Norm C 18-510	http://www.boutique.afnor.org/norme/nf-c18-510/operations-sur-les-ouvrages-et-installations-electriques-et-dans-un-environnement-electrique-prevention-du-risque-electrique/article/794873/fa173528	Operations on structures and electrical installations and within an electric environment - Prevention of electrical hazards. Article R4544-10, Created by Decree No. 2010-1118 of 22 September 2010 - s.1: A worker is entitled within the limits of the powers entrusted to it. The authorization issued by the employer, specifies the type of operations they are authorized to perform. Before issuing an authorization, the employer shall ensure that workers received training and education which gives him the knowledge of the electrical hazards and measures to respond to safety during the execution of operations assigned to it. The employer shall issue, maintain or renew the authorization on the terms contained in the standards mentioned in Article R. 4544-3. The employer gives each worker a backlog requirements established on the basis of the relevant requirements of these standards, supplemented, where appropriate, by specific safety instructions at work. Article R4544-11, Created by Decree No. 2010-1118 of 22 September 2010 - s.1: Workers who perform live work hold a specific authorization. The FSC is granted by the employer after certification of workers by an accredited certification body. An order of the Ministers of Labour and fixed agriculture: 1. The skills required for workers who perform live work; 2. The evaluation criteria used by the certification body; 3. The standards in view of which are accredited certification bodies

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28	Electrical Safety (Design and Operation)	INRS Guidance article "Réglementation et prévention des risques électriques"	http://www.inrs.fr/accueil/risques/phenomene-physique/electricite/reglementation.html	The regulations for electrical risk prevention is divided into 2 parts. One is for owners and covers the design and construction of electrical systems for the construction and layout of buildings. The second is for employers who use electrical installations or perform operations on or near electrical installations. Electrical hazards prevention regulations contained in the Labour Code. They are from 4 decrees issued in 2010 and supplemented by decrees issued since late December 2011. (...) Design and implementation of electrical installations The client designs and manufactures electrical installations of the workplace in accordance with the Labour Code (Articles R. 4215-1 to R. 4215-17). These provisions also apply to self-employed workers and employers who directly carry out an activity on a site. The employer realizing new electrical installations, additions or modifications of facilities, meets some of these obligations (Article R. 4226-6 of the Labour Code). These requirements are intended to protect the health and safety of workers against the risks of: • electric shock by direct or indirect contact, • burning, • Fire, • explosion of electrical origin. Main obligations of the owner for electrical installations: • Health and safety rules set by the Labour Code are expressed in terms of targets for the elimination or reduction of defect electrical hazards. • The contractor shall prepare and send to the employer a technical file describing electrical installations in the manner established by decree. • Compliance with approved installation standards resulting presumption of conformity with regulatory requirements. The list of standards of installation is fixed by the decree. An employer who uses electrical installations (permanent and temporary) on the workplace must respect the rules of the Labour Code (Articles R. 4226-1 to R. 4226-21). Main duties of the employer for the use of electrical installations: • Keep electrical installations in accordance with the design rules which are applicable on the date of commissioning

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				• Ensure the monitoring and maintenance of facilities and electrical equipment • Check or have checked the electrical installations The initial or periodic verification of electrical installations are performed by an accredited organization Accréditéorganisme Organization that received a certificate COFRAC by the French Accreditation Committee or a recognized organization at European level. The employer may decide to entrust periodic checks by a qualified person belonging to the company, recognized as competent according to criteria set by decree. Additional preventive measures are to be taken in the premises or hazardous locations (ATEX regulations, Articles R. 4227-42 to R. 4227-54 of the Labour Code). Decrees set specific preventive measures concerning: • electric welding installations with, in normal operation, individual risk of electric shock, • removable appliances, • emergency lighting. Operations on or near electrical installations The Labor Code sets the rules to follow during operations on or near electrical installations, with the exception of distribution facilities of electric power and electric power plants. The employer shall take preventive measures to eliminate or, failing that, to minimize electrical hazards: • perform work off unless the risk assessment shows that it is technically impossible or operating conditions make it dangerous power off, • limit the operations in the vicinity of exposed live parts to cases where it was not possible to remove this neighborhood by recording the installation or, failing that, by ensuring the distance protection, barrier or insulation, • in the case of non-electrical order operations, limit them to only operations required by the operation or maintenance of electrical installations. Specific measures complement these general steps: • for running off work: recording and tagout, • for work performed in the vicinity of bare energized parts in high voltage areas: continuous monitoring by an authorized person access

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				reserved to persons holding a security clearance (except for non-electrical work order) • for live work: written order of the head of the institution in which they are executed justifying the need to work on, establishing procedures, choice of work equipment, personal protection and appropriate work clothing . Empowerment for work on or near electrical installations: • Empowerment is mandatory. The employer delivers it after making sure that workers are fit by the doctor and they have received theoretical and practical training on electrical hazards and proper safety measures in the work. • In the case of work on, the clearance is issued by the employer after certification of workers by an accredited certification body. • Self-employed and employers directly intervening on sites do not have to be empowered, but they must have knowledge of the risks associated with electricity and prevention measures.
29	Working at height regulations (1)	Code du Travail, Partie legislative Nouvelle, Quatrieme partie (sante et securite au travail), article 4121-1 to 4121-5	http://www.legifrance.gouv.fr/affichCodeArticle.do;jsessionid=F35C843D6E1D4D87EE316787198FAC6E.tpdjo03v_3?cidTexte=LEGITEXT000006072050&idArticle=LEGIARTI000006903147&dateTexte=&categorieLi	Employer's Obligations: Article L4121-1, Edited by ION 2010-1330 of 9 November 2010 - s. 61: The employer shall take the necessary measures to ensure the safety and protect the physical and mental health of workers. These measures include: 1. Actions occupational risk prevention and strain at work; 2. Informative and training actions; 3. The establishment of an organization and suitable means. The employer shall ensure the adaptation of these measures to take account of changing circumstances and aim to improve existing situations. Article L4121-2, Edited by ION 2012-954 of 6 August 2012 - art. 7: The employer shall implement the measures provided for in Article L. 4121-1 on the basis of the following general principles of prevention: 1. Avoid risks; 2. Assess risks that cannot be avoided; 3. Combat risks at source; 4. Adapt the work to the individual, especially as regards the design of workstations and the choice of work equipment and methods of work and production, particularly in order to limit the monotonous work and work clocked and reduce the effects of these on health;

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			en=cid	5. Consider the development of the technique; 6. Replace the dangerous by what is not dangerous or less dangerous; 7. Plan prevention by integrating - in a coherent way - technology, organization of work, working conditions, social relationships and the influence of environmental factors, including risks related to bullying and sexual harassment, as defined in Articles L. 1152-1 and L. 1153-1; 8. Take collective protection measures giving them priority over individual protective measures; 9. Give appropriate instructions to the workers. Article L4121-3, Edited by ION 2014-873 of August 4, 2014 - s. 20: The employer, given the nature of the activities of the institution assesses the risks to the health and safety of workers, including in the choice of manufacturing processes, work equipment, the chemical substances or preparations in the development or redevelopment of workplaces or facilities and in defining the workstations. This risk assessment takes into account the differential impact of exposure to risk by gender. Following this assessment, the employer shall implement preventive actions and methods of work and production to ensure a better level of protection of health and safety of workers. It integrates these actions and methods in all activities of the institution and at all levels of management. When the documents required by the regulations made for the purposes of this section must be updated, it may be less common in companies with fewer than eleven employees, subject to be guaranteed a equivalent level of protection of the health and safety of workers under conditions established by decree of the State Council after consultation of the professional organizations;

#	Subject	Law	Link	Content (English)
30	Working at height regulations (2) - Training requirements	INRS guidance (INRS - Work at height and Aptitude (qr63))	http://www.inrs.fr/accueil/situations-travail/hauteur.html	Regulatory framework of the Work at Height: Priority to permanent installations and collective protection. The regulations do not define the work at height. It is for the employer to ascertain the existence of a risk of falls in the risk assessment. The Labor Code specifies the rules for the design, development and use of workplaces and for the design and use of equipment for work at height. Special rules apply to the construction sector and certain categories of workers. The specific laws and regulations in work at height are essentially contained in the Labor Code. The risk of falling from a height as other risks to which a worker may be exposed in the course of its business, is covered by the general provisions of the Labor Code (Articles L. 4121-1 to 5). Prevention is treated under general principles of prevention. (/accueil/demarche/abc/pgp.html). (...) • "It is forbidden to use access and positioning techniques using ropes to form a workstation" (Article R. 4323-64). Finally, regardless of the installation or equipment, it is forbidden to carry out work at height when weather conditions (high winds, storm ...) or conditions related to the workplace environment are likely to impair the safety and health of workers (Article R. 4323-68). (...) Specific verification measures (material, equipment, facilities and protection devices of any kind used on construction) must be taken by a competent person is placed in or returned to service. A record of observations on the state of the material must exist on site (Articles R. 4534-15 to R. 4534-20). In case of absence or failure to implement measures to protect against falls from height: On a construction site, a situation of this type is considered a serious danger and imminent danger to the life and health of workers. As such, this may be a temporary stoppage of work in progress by the Labor Inspector (Article L. 4731-1). Work prohibited for young workers: On building sites and public works, it is prohibited to employ young workers under the age of 18 for elevation work (Article D. 4153-36 of the Labor Code). The following works are also prohibited: • work on suspended platforms, suspended scaffolds, suspended ladders and aerial platforms on masts, boom lifts, • assembly and dismantling of scaffolding and any other protective

#	Subject	Law	Link	Content (English)
				devices. However, exceptions may be granted, especially for students and apprentices getting a degree of technological or vocational education (Article D. 4153-48).
31	Working at height regulations (3) - Training requirements	Work or roped access and strings positioning (Travail encordé ou accès et positionnement par cordes)	http://www.inrs.fr/accueil/situations-travail/hauteur/travail-encorde.html	Conditions for use of rope access and positioning techniques, which are subject to regular inspections, are outlined here. • The system should include at least one working line, constituting a means of access, descent and support, and a safety rope equipped with a fall arrest system. These two devices are anchored separately and the two anchor points are subject to calculation note prepared by the employer or a competent person. • Workers are to be provided with an appropriate fall arrest harness, use and are connected by this harness to the lifeline and the work rope. • The working line is equipped with a safe mechanism for lowering and raising and has a locking system that prevents the fall of the user if he lose control of his movements. The safety rope is equipped with a mobile fall prevention system which follows the movements of the worker. • Tools and other accessories to be used by a worker are attached by suitable means, so as to prevent them from falling. • The work is planned and supervised so that a worker can be rescued immediately to the worker in case of emergency. • Workers receive adequate training specific to the operations envisaged and rescue procedures. Regulation particularly emphasizes the need for appropriate training. This training must meet the general criteria set out in the Labor Code:

#	Subject	Law	Link	Content (English)
				• work execution conditions (Article R. 4141-13) • what to do in case of an accident (Article R. 4141-17) • renewal terms of these formations (Article R. 4323 3). Specific training diplomas Two degrees can acquire travel techniques on ropes and master the rules of safety and prevention of accidents: • The certificate of proficiency rope work (CATSC) is obtained after several months of work experience and training course organized by some Greta. • The certificate of qualification for rope access (CQP) is preparing training continues after building training or mountaineer.
32	Regulation regarding PPE (1)	Code du Travail, articles R. 4311-8 à R. 4311-11; articles L. 4321-1 à L. 4321-5 ; articles R. 4321-4 à R. 4322-3., R. 4323-91 à R. 4323-106.	http://www.legifrance.gouv.fr/affichCode.do?cidTexte=LEGITEXT000006072050&dateTexte=20131220	**Definitions and Exclusions**: Articles R. 4311-8 to R. 4311-11 **Use of PPE** - General requirements, continued compliance status, instructions: Articles L. 4321-1 to L. 4321-5; Articles R. 4321-4 to R. 4322-3. - Characteristics, conditions, periodic audits training and information of workers: Articles R. 4323-91 to R. 4323-106.

#	Subject	Law	Link	Content (English)
33	Regulation regarding PPE (2)	INRS guidance document	See document "INRS - Les équipements de protection individuelle (EPI) (ed6077)"	The personal protective equipment (PPE) is to protect the worker against one or more risks. Their use should be considered in addition to other measures to eliminate or reduce risks. The rules relating to their design and use are defined by the Labor Code. This paper presents in the form of questions and answers, the main legal rules concerning the placing on the market of PPE and the conditions of their provision by employers.(...) Check PPE before use with every use: PPE must be a maintained, audited for compliance status with the design of technical rules applicable to them. To do this, you should check PPE deterioration indicators (wear of components ...) and to check the date or time of expiration. Periodic Checks: The realization of periodic audits by the employer allows it to ensure the continued PPE compliance status and, if necessary, make the necessary repairs or replacement of these PPE. It is for the employer to define the frequency and nature of these checks and to ensure they are carried out by a competent person inside and outside the company. The frequency of checks must be adapted to constraints faced by PPE during use (contact with chemicals, wear ...). It will take into account the information provided by the manufacturer in the instructions. Moreover, for some PPE, regulations require the employer the nature and frequency of these checks. The employer shall make or cause make these general periodic checks so that is detected in good time of any defects that could cause dangerous situations. It is also necessary to check that the PPE accessibility conditions are adapted to the work situation (Article R. 4323-99). For example, anti-gas replacement filter cartridges should be permanently accessible to all workers to renew the filter from the camera respiratory protection. The decree of 19 March 1993 (OJ of 28 March 1993) defines the nature and frequency of these checks (minimum every twelve months) for the following PPE: - Self-contained breathing apparatuses for evacuation, - Breathing apparatus and complete equipment for accidental intervention in hostile environment, - Inflatable lifejackets - Individual protection system against falls from

#	Subject	Law	Link	Content (English)
				height offshore - Stocks of anti-gas filter cartridges for respirators.
33	Work Restrictions due to high temp.& low tempr.	Code du Travail - Article 4121-1; - Article R. 4225-1 workstations outdoors (3, a) employee protection against	http://www.legifrance.gouv.fr/affichCode.do;jsessionid=70288B21AEB6BA264456BBF72E52FD26.tpdjo11v_2?cidTexte=LE	No indication of minimum or maximum temperature is given in the labor Code. Obligations of the employer The employer shall implement the necessary measures to ensure the safety and protect the health of workers (Article L. 4121-1 of the Labor Code), pursuant to the general principles of prevention of the labor Code. It must take into account the temperature conditions in the risk assessment and implement appropriate preventive measures. The employer shall provide situations outside work to ensure, to the extent possible, the protection of workers against atmospheric conditions (Article R. 4225-1 of the labor Code).SOURCES REGULATORY - Article R. 4225-1 workstations outdoors (3, a) employee protection

#	Subject	Law	Link	Content (English)
		weather conditions - Article R. 4213-7 Thermal Atmosphere : equipment design and characteristics of workplaces are designed to allow adjustment of the temperature of the human body during the hours of work, taking into account the working methods and physical constraints supported by workers - Article R. 4213-8 equipment and features ancillary	GITEXT000006072050&dateTexte=20131220	against weather conditions - Article R. 4213-7 Thermal Atmosphere : equipment design and characteristics of workplaces are designed to allow adjustment of the temperature of the human body during the hours of work, taking into account the working methods and physical constraints supported by workers - Article R. 4213-8 equipment and features ancillary rooms to workplaces , including health , rehabilitation and medical facilities are designed so that the temperature adaptation to the specific purpose of such areas - Article R. 4223-13 Thermal Atmosphere : enclosed spaces in which work is heated during the cold season . heating functions to maintain proper temperature and not give rise to any deleterious emanation - R 4223-15 : the employer shall , after consulting the doctor and the health, safety and working conditions committee or, failing this, representatives, all necessary measures to ensure the protection of workers against and cold weather

#	Subject	Law	Link	Content (English)
		rooms to workplace s , including health , rehabilitati on and medical facilities are designed so that the temperatu re adaptation to the specific purpose of such areas - Article R. 4223-13 Thermal Atmospher e : enclosed spaces in which work is heated during the cold season . heating functions to maintain proper temperatu re and not give rise to		

#	Subject	Law	Link	Content (English)
		any deleterious emanation - R 4223-15 : the employer shall , after consulting the doctor and the health, safety and working conditions committee or, failing this, representatives, all necessary measures to ensure the protection of workers against and cold weather)		
34	Regulations regarding use of contractors	Code du Travail, Partie Legislative nouvelle, Quatrieme partie (sante et securite au travail),	http://www.legifrance.gouv.fr/affichCode.do?cidTexte=LEGITEXT000006072050&dateTexte=20131	Article R4511-1: The provisions of this title shall apply to the CEO of the user company and the CEO of the subcontractor company when an external subcontractor deploys workers to perform or participate in the execution of an operation, whatever its nature, in a location of the user company, including its dependencies or sites.

#	Subject	Law	Link	Content (English)
		Livre V (), Titre Ier (TRAVAUX RÉALISÉS DANS UN ÉTABLISSEMENT PAR UNE ENTREPRISE EXTÉRIEURE)	212	
35	Relevant International Standards (IEC)	IEC Standards for Wind Turbines (EN 61400 series)	http://www.iec.ch/dyn/www/f?p=103:7:0::::FSP_ORG_ID:1282	See standards published by IEC Technical Committees and Subcommittees TC 88 (Wind Turbines).
36	Protective Measures related to Health and Safety applied to WTGs	Standard FprEN 50308:2013 "Wind turbines. Protective measures. Requirements for design, operation and maintenance"	http://www.cenelec.eu/dyn/www/f?p=104:110:759526678290544::::FSP_PROJECT,FSP_LANG_ID:21340,25	This European Standard specifies requirements for protective measures relating to health and safety of persons, domestic animals and property, to be incorporated into the design, operation and maintenance of wind turbines. The requirements cover the potential danger zones inside and in the environment of a wind turbine where persons, domestic animals and property may be exposed to hazards from the wind turbine. This standard covers the safety issues of the wind turbine itself and the directly related material, equipment and processes essential for the safe operation of the complete system. This also includes switchgear outside the tower, internal grid, grid connection, and any means of access. This European Standard does not cover the structural design of the wind turbine. This European Standard is not applicable to wind turbines manufactured before the date of its publication by CENELEC

#	Subject	Law	Link	Content (English)
37	Fire Risk Inspection	Labor Code, regulatory section, Part 4: Health & Safety Book V: Fire Risk to Certain Activities Title I: Works in an establishment by a foreign company. Chapter II	http://www.legifrance.gouv.fr/affichCode.do;jsessionid=0894FEF8C774B13CC4A41066C36DD4CF.tpdjo11v_2?idSectionTA=LEGISCTA000018529787&cidTexte=LEGITEXT000006072050&dateTexte=20131219	Article R4512-8 More about this article ... Created by Decree No. 2008-244 of 7 March 2008 - s. (V) The measures provided for the prevention plan include at least the following: 1. The definition of dangerous activity phases and corresponding specific means of prevention; 2. Adaptation of materials, equipment and devices to the nature of the operations being performed and the definition of their maintenance conditions; 3. The instructions to the workers; 4. The organization set up to provide first aid in emergencies and description of the system set up for this purpose by the user enterprise; 5. The conditions of participation of workers to the work of another in an enterprise in order to ensure the coordination necessary to maintain security and, in particular, the command organization.

Appendix I.

Bulgarian Regulations

#	Subject	Law	Link	Content (English)
1	Axel pressure, heavy transportation regulations (WTG transportation)	Ordinance № 11 of 3 July 2001, for the movement of oversized and / or heavy road transport means (amended, Art. - SG. 67 2007) (Article 5 (para. 1-2); Article 6 (para.1-3); Article 8 (para.1-3))	http://www.lex.bg/bg/laws/ldoc/-549157889	(New - SG. 67, 2007) The maximum distance between the central axis of the bolt which connects the cradle and the rear part of the semi-trailer is 12,00m (New - SG. 67 2007) The horizontal distance measured between the axis of the central bolt which connects the cradle and any point on the front part of the semi -trailer must not exceed 2,04 m. Maximum mass of HVG allowed on the roads: a) trailer with 2 axes:18t b) trailer with 3 axes: 24t (Am. - SG. 67 of 2007), HVG made up from 5,6 or more axes: a) (Am. - SG. 67 of 2007) HVG with 2 axis and a trailer with 3 or more axes: 40t b) (Am. - SG. 67 of 2007) HVG with 3 axis and a trailer with 2, 3 or more axes: 40t The movement of heavy HVG is carried out within the framework of a special use of the roads and is only permitted when any other means of transport are considered as inappropriate and impossible or when the cargo cannot be disassembled. Oversized HVG can only be used on the roads when a permit is issued by administration which controls the roads and is in accordance with the relevant department of inspection of the roads of the Ministry of Interior (MoI).

#	Subject	Law	Link	Content (English)
2	Bird Migration - Restricted Operational Months	Law for the biological diversity (Article 6 (para.3&4); Article 7 (para.3); Article 31; Chapter Three. Section V.	http://lex.bg/laws/ldoc/2135456926	This regulation prohibits wid farm operations during the bird migration periods. In accordance with this regulation the state inspectors have right to stop the wind farm construction activities, if it is found that the regulations are not observed. Art. 6. (1) Protected zones shall be declared for: 3. (amend. – SG 94/07) preservation of habitats of the species under the Directive 79/409/EEC of the Council on the conservation of wild birds – for the species of birds, listed in Annex No. 2; 4. preservation of territories where during the time of reproduction, pining, hibernation or migration a considerable number of birds gather, other than those under Appendix No 2. Art 7. (3) The territories including habitats of the species of birds according to Appendix No 2 and of the territories under Art. 6, Para 1, Item 4 shall be subject to assessment on the grounds of the following indices: 1. Size and/or density of the population of the species during nesting, hibernation or migration as compared with the size and/or density of the population of the same species in Europe and in the Republic of Bulgaria; 2. Degree of representation of the habitat of importance for the species on the respective territory; 3. General assessment of the importance of the territory for the preservation of the respective type on the grounds of the quantity of the indices under Item 1 and 2. Art. 31. (Amended - SG. 88 of 2005, amended. - SG. 52 of 2007) (1) (suppl. - SG. 62 of 2010 with effect from 30.09.2010 on) plans, programs, projects and investment proposals that are not directly connected with or necessary to the management of protected areas and which individually or in combination with other plans, programs, projects or development proposals may have a significant negative impact on protected areas be evaluated for their compatibility with the object and purpose of the conservation of the protected area.

#	Subject	Law	Link	Content (English)
3	Carbon/Epoxy Fumes emission regulation requirements	Law of preservation of environment(Article 131) Ordinance № 2 of February 19, 1998 for standards for admissible emissions (concentrations in waste gases) of harmful substances, emitted in atmospheric air from immovable sources(chapter four. Standards for emissions from immovable sources) Ordinance № 7 of September 23, 1999 for the minimal requirements for	http://lex.bg/laws/ldoc/2135458102 http://www.lex.bg/bg/laws/ldoc/-549951487 http://www.lex.bg/bg/laws/ldoc/-549670400	Art. 131a. (new – SG 77/05) (1) Scheme for trade with quotas for emissions of greenhouse gases shall be created. (2) The scheme for trade with quotas for emissions of greenhouse gases shall be opened for participation of Bulgarian individuals and corporate bodies as well as of individuals and corporate bodies of the member countries of the European Union and such from third countries in compliance with the international contracts and agreements to which the Republic of Bulgaria is a party. Art. 131b. (New - SG. 77 of 2005, amended. - SG. 46 of 2010, effective 18.06.2010) (1) The allocation of quotas for greenhouse gases from 2007, and for the period 2008 - 2012 budget has been conducted in accordance with the National Plan for allocation to trade greenhouse gas emissions, prepared and adopted pursuant to Art. 77a. Art. 131v. (New - SG. 77 of 2005) (1) (suppl. - SG. 65 of 2006, effective 11.08.2006, amended. - SG. 46 2010, effective 18.06.2010, amended. - SG. 42 of 2011, amended. - SG. 32 of 2012, effective 24.04.2012) The operation of new and operation of existing installations for categories of industrial activities listed in Annex № 4, item 1.1, 1.2, 1.3, 2.1, 2.2, 3.1, "b", 3.3, 3.5, 6.1, letters "a" and "b "shall be permitted after the issuance of a permit to emit greenhouse gases. ************************* Art. 18. (1) (prev. text of Art. 18 - SG. 43 of 2003) shall not be allowed to exceed the established norms for production microclimate, noise, vibration, dust, toxic substances, lighting, non-ionizing and laser radiation in workplaces. (2) (New - SG. 43 of 2003, amended. - SG. 40 2008) Workers should not be exposed under any circumstances due to increased risks of working in confined spaces. (3) (New - SG . 40 of 2008) For working in confined spaces provide a continuous surveillance outside and take all appropriate measures to provide effective and immediate assistance. Art. 20. Processes and activities with the release of dust , toxic and other harmful substances, noise and vibration than the established norm presence of ionizing radiation, infrared radiation, ultraviolet radiation, lasers, electromagnetic fields, overheating microclimate wet processes, etc. organized in separate buildings or premises in

#	Subject	Law	Link	Content (English)
		healthy and safe conditions of work at the working places and in using the working equipment (Art.18, 20)		compliance with the respective type of business regulations to ensure the health and safety and fire safety.
4	Confined Space	Ordinance № 2 of March 22, 2004 for the min H&S requirements for carrying out construction and mounting works (Art.47) Ordinance № 7 of Sept 23, 1999 for the min	http://www.lex.bg/bg/laws/ldoc/2135484002 http://www.lex.bg/bg/laws/ldoc/-549670400	Art. 47. (1) (new – SG 102/06) In case of working in places in limited spaces, where the air can become flammable or it contains toxic or hazardous substances, or when there is no enough oxygen, the air shall have to be put under permanent control, whereas respective measures for prevention of the hazards shall be undertaken. (2) (prev. art. 47 – SG 102/06) Construction and mounting works in limited spaces (wells, tunnels, ditches, closed and semi-closed vessels, etc.) shall be carried out according to the safety and health instructions, developed for each specific case. Art. 18. (1) (prev. text of Art. 18 - SG . 43 of 2003) shall not be allowed to exceed the established norms for production microclimate , noise , vibration , dust, toxic substances , lighting, non-ionizing and laser radiation in workplaces and workplaces . (2) (New - SG. 43 of 2003, amended. - SG. 40 2008) Workers should not be exposed under any circumstances due to increased risks of working in confined spaces. (3) (New - SG. 40 of 2008) For working in confined spaces provide a continuous surveillance outside and take all appropriate measures to

#	Subject	Law	Link	Content (English)
		H&S requirements for using work equipment (Chapter 12 Activities in times of accidents (Article 18)		provide effective and immediate assistance.
5	Construction works - wind farm	Constitution of the Republic of Bulgaria (Art. 3) Ordinance no 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementing construction and mounting works (Article 5;Article 16, para.1(f); Article19)	http://lex.bg/laws/ldoc/521957377 http://www.lex.bg/bg/laws/ldoc/2135484002	Art. 3. Bulgarian shall be the official language of the Republic. 5. (1) (amend. – SG 102/06) The assignor or the person, authorized by him, shall determine coordinators of safety and health: 1. for the stage of the investment designing – when he assigns the designing to more than one designer; 2. for the stage of fulfilment of the construction – when he assigns the fulfillment of the construction to more than one constructor or to a contractor, hiring subcontractor(s). (2) The coordinators of para 1 must be legally competent persons with qualification, professional experience and technical competence in the field of designing, construction and safe and healthy fulfilment of construction works proven respectively with diploma, licenses, certificates etc. (3) The functions of coordinator of safety and health can fulfil: 1. for the stage of the investment designing also by: a) consultant (for constructions of all categories); b) person with full designer legal competence (for constructions of first to fourth category); 2. for the stage of fulfilment of the construction also by: a) consultant (for constructions of all categories); b) technical manager (for constructions of fifth category). (...) Art. 16. The constructor shall: 1. ensure: f) the instructions, the training, the increasing of qualification and the check of the knowledge for safety requirements of the workers. (...) Art. 19. (1) The instructions for safety and health shall contain: 1. the rights, the obligations and the responsibilities of the persons,

#	Subject	Law	Link	Content (English)
				who manage or guide the respective labor processes; 2. the required legal competence or qualification of the workers for implementing construction works for defined construction technologies and of the operators of construction machinery and instruments; 3. the requirements for safety; a) before starting, during and upon stopping, termination and finishing of the work; b) for use of the respective construction machines and the other working equipment; c) at making trials and checks for functionality of technological equipment and installations; 4. (suppl. – SG 102/06) a list of resources for collective protection and the personal protection aids, necessary for fulfilment of the work, giving priority to the collective before the personal; 5. (new – SG 102/06) rules of storage, keeping and application of the used products and items; 6. the conditions for compulsory and emergency termination of work, measures for rendering first aid to the injured upon accident etc.; 7. (amend. – SG 102/06) scheme for placing of the signs for safety of labor and fire safety (FS) and of the places for placing the descriptions of the signals, made with hand, and of the verbal messages, which upon need are made at work. 8. (prev. item 5 – SG 102/06) other requirements, connected with the concrete conditions of work; (2) The instructions of para 1: 1. shall be put at accessible and visible places in the working zone; 2. shall be updated at any change and contain the dates, on which are approved and changed.

#	Subject	Law	Link	Content (English)
6	Dangerous goods oil, diesel (maximum volume, classifications) for WTG service vans	Automobile Transport Act (Article 106)	http://www.lex.bg/bg/laws/ldoc/2134681089	(NEW - SG . 99 of 2003 , in force since 12.12.2003 , amended - SG. 80 of 2007, in force since 05.10.2007)(1) Vehicle carrying dangerous goods shall be suspended from movement to remedy the situation when: 1. dangerous goods forbidden for transport; 2. established leakage of hazardous substances from the vehicle due to compromised integrity of tanks or packages; 3. vehicle is not designed for the load carrying ; 4. are carried in a container with a structure that is not designed to serve ; 5. vehicle without a certificate of approval for the transport of dangerous goods; 6. used containers are not approved in accordance with the European Agreement concerning the Carriage of Dangerous Goods by Road (ADR); 7. packages do not meet the packaging instructions; 8. are not complied with the rules for mixed packing; 9. are not complied with the rules for mixed loading of packages; 10. dangerous goods are transported in containers no markings and danger labels; 11. driver drives a vehicle with unfortified load; 12. not met the requirements of the European Agreement concerning the Carriage of Dangerous Goods by Road (ADR) in respect of the permissible degree of filling of tanks and containers; 13. are not complied with the rules relating to provisions limiting the amount of substances transported in a vehicle; 14. driver brings transportation and accompanying documents pursuant to the ordinance under Art. 14, para.1; 15 . vehicle without the proper identification sign for dangerous goods or novelty character 16. no information on dangerous substances (UN, name the European Agreement concerning the carriage of dangerous goods by road (ADR), packing group); 17. the driver does not hold a certificate under Art. 14, para.2; 18. using illumination are not in compliance with the European Agreement concerning the Carriage of Dangerous Goods by Road (ADR); 19. the vehicle does not meet the requirements of the European Agreement concerning the Carriage of Dangerous Goods by Road

#	Subject	Law	Link	Content (English)
				(ADR).

#	Subject	Law	Link	Content (English)
7	Discharging vessel (Transportation by sea/river) Offshore WTG maintenance vessels, crew transfer boats	law for the sea waters, the internal water ways and the ports of the Republic of Bulgaria (Article 53 (para 1-4); Article75)	http://www.mtitc.government.bg/page.php?category=213&id=524	Art. 53. (1) The discharge, the throwing or sinking from ships, aircraft, platforms and other artificial facilities and from coast sources of any solid and liquid waste or substances harmful for the health of people or the live resources of the sea as well as any other pollution or sea environment in the internal sea waters and in the territorial sea shall be prohibited except when the standards provided in international conventions ratified by the Republic of Bulgaria and in the national legislation. (2) The pollution of sea waters in the exclusive economic zone that could impair the interests of the country as well as the throwing out and discharge of wastes and substances above the admissible international standards and norms adopted by the Republic of Bulgaria shall be prohibited. (3) (Amend. – SG 65/06, in force from 11.08.2006) The outfall of waste waters from coast sources shall be regulated through the Law for the waters. (4) (New – SG 99/06, in force from 09.01.2007). Any other contamination from vessels, located in the sea waters of the Republic of Bulgaria shall be prohibited, including air pollution, unless subject to observance of the norms, provided in international conventions, ratified by the Republic of Bulgaria and in our national legislation. (new – SG 99/06, in force from 09.01.2007) Pouring out, discharging and sinking from vessels of any kind of solid and liquid waste and of any other harmful for the health of humans or living resources of the internal water ways substances shall be prohibited in the internal water ways, as well as any other contamination, including air pollution, unless subject to observance of the norms, provided in international conventions, ratified by the Republic of Bulgaria and in our national legislation.
8	Drug and alcohol policy	Health Law(art.53) Ordinance no 2 of March 22, 2004 for the minimum requirements for	http://www.lex.bg/bg/laws/ldoc/2135489147 http://	Art. 53. (1) The Minister of Health and other relevant government authorities together with non-governmental organizations create conditions to restrict smoking, alcohol abuse and non-use of drugs (....) (4) The municipalities adopt and implement regional programs to curb smoking, alcohol abuse and non-use of drugs. Art. 29. At the instruction the workers, who fulfil CMW, shall obligatory be informed about their obligations to: 2. appear to work in sober state and not to consume alcohol and intoxicating

#	Subject	Law	Link	Content (English)
		healthy and safe labor conditions at implementing construction and mounting works (Article 29)	www.lex.bg/bg/laws/ldoc/2135484002	substances during working time;
9	Electrical safety regulations (for commissioning and start-up)	Ordinance no 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementing construction and mounting works (Chapter two. Construction machines and devices; Article 54; 20) Ordinance № 9 of 9 June 2004	http://www.lex.bg/bg/laws/ldoc/2135484002	Art. 54. Before the beginning of construction works for the air electric power-lines existing on the construction site shall be applied one of the following measures: 1. movement at a safe distance from the region of the construction site; 2. switching of the voltage in them; 3. upon impossibility for switching off shall be put: a) barriers (fences) or signs and signals, so that to be ensured safe distance to the electric power-lines; b)(amend. – SG 102/06) appropriate warning facilities and suspended protections if under them motor vehicles will pass. Art. 54a. (new – SG 102/06) No construction works shall be allowed, neither allocation of production bases, warehouses and sanitary and rest rooms in the servitude zone of electrical lines, gas pipelines and other ducts. Art. 20. The instructions for safety and health at exploitation of electric facilities and working equipment shall include also issues about: 1. the way of hanging of cables with length over 3 m and minimum suspension 2.5 m; 2. safeguarding against damages from electric currency of the used electrified wagons, barracks, containers etc. according to the instruction for exploitation; 3. the periodicity of the check of the electric safeguarding, including also by measurements; 4. marking the existence of voltage and the power of the used contacts and extensions;

#	Subject	Law	Link	Content (English)
		on the technical operation of power plants and networks (Art6, 7, 8, 13,14,97, 99)	http://www.lex.bg/bg/laws/ldoc/2135489714	5. the use of portable transformers, lamps and electric appliances and instruments; 6. the check of the effectiveness of the lightning protection in case such is required. ************** Art. 7. Prior to the adoption of energy projects carried out: 1. single trials of equipment and functional tests of different systems; 2 . Test run of the main and auxiliary equipment of power units; 3 . Complex tests; 4 . Seventy-two hour tests under operating conditions. Art. 8. (1) Unit testing facilities and functional samples of the different systems is done after the completion of construction and installation work on the project schemes. (...) Art. 14. Upon delivery of equipment and buildings in operation unless the documentation prepared under Ordinance № 7 of the 1999 compilation of documents and reports during construction (promulgated, SG. 72 of 1999, amended. No.96th 1999) , must be formed and transmitted by the investor to the owner / user of the site and the following documents: protocols for testing safety systems, systems for ventilation of rooms with radioactive contamination, fissile material and sources of ionizing radiation - from the companies, which is carry out the setting. (...) Art. 97. Energy companies in accordance with the regulations provide a safe and healthy working conditions of workers their jobs wherever they are located, and to implement safety measures to all other persons who for other reasons are in or near workplaces, sites or locations throughout the energy facilities. (...) Art. 99. Energy companies are obliged to organize: 1. Fulfillment of the requirements of the regulations on safety and health at work, provide control over working conditions and to provide data for them in the cases determined by the Health and Safety at Work. 2. Training and Assessment, instruction and supervision of employees. 3. Conducting training and checking the skills of workers in rendering

#	Subject	Law	Link	Content (English)
				first aid to victims of electrocution , accidents , industrial accidents, etc.
10	Emergency rescue requirements	Ordinance no 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementing construction and mounting works (Article 74-75)	http://www.lex.bg/bg/laws/ldoc/2135484002	Art. 74. At giving signal for emergency situation the technical manager or a person, appointed by technical manager shall undertake the following measures: 1. evacuate all the workers in the quickest and safe way; 2. (revoked – SG 102/06) 3. terminate any works at the place of the accident and in the neighboring threatened sections of the building or the facility; 4. switch off the voltage, supplying power to any equipment in the accident section; 5. in the shortest term inform the workers, who are exposed or can be exposed to serious or immediate danger from the existing risks as well as about the actions for their protection; 6. undertake activities and give orders for immediate terminating of the work and leaving of the working places; 7. organize liquidation or localization of the fire or the accident by using protective and safe instruments and facilities; 8. order removing of the workers, who do not participate in the fight with the fire or the accident at a safe place; 9. upon fire stop the activity of the ventilation when in the accident section there is such; 10. put guard on duty at the entrances and the exits of the construction site; 11. do not resume work till there is no serious and immediate danger. Art. 75. The constructor shall revoke the emergency status after ultimate removal of the reasons for the accident, upon impossibility for its repeating, dissemination or expansion, as well as under the condition that all necessary measures are undertaken for full safeguarding of the persons and the devices at resuming of the work.

#	Subject	Law	Link	Content (English)
11	Emergency response plans	ACT Disaster Protection(Art. 35, 36) Ordinance no 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementing construction and mounting works (Article 10; Section VI Actions in Case of Accidents (new – SG 102/06))	http://www.lex.bg/bg/laws/ldoc/2135540282 http://www.lex.bg/bg/laws/ldoc/2135484002	Art. 35. (Amended - SG. 80 of 2011, in force from 14.10.2011) (1) Legal persons and sole proprietors, owners and users active in the sites of construction first, second and third category art. 137 of the Law on Spatial Planning, which is a risk for the occurrence of a disaster, develop an emergency plan of the site, which include: 1. maximum possible effects on personnel, population and environment from an accident at the site; 2. measures to limit and mitigate the consequences of an accident at the site; 3. measures to protect personnel ; 4. division of duties and responsible bodies and individuals for implementation of the measures envisaged. Art. 36. (Amended - SG. 80 of 2011 , in force from 14.10.2011) (1) Legal persons and sole traders except those under Art. 35 operating in industrial buildings and public service buildings, structures representing first, second and third category of art. 137 of the Law on Spatial Planning, draw up a plan for disaster protection of residents, which include: 1. risks for the site under the municipal plan for disaster protection; 2. measures to protect residents; 3. allocation of responsibilities, structures and individuals responsible for implementing the measures envisaged; 4. resources needed for the implementation of the measures envisaged; 5. standby time response of structures and persons under item 3; 6. how to interact with a component of a rescue system. ****** Art. 10. the plan for safety and health shall contain scheme and kind of the signalization for disaster, average, fire or accident, with defined place for rendering first aid. (...) Art. 73. (amend. – SG 102/06) (1) In case of an accident the constructor shall announce accident situation and shall follow the execution of the measures, provided in the plan of prevention and elimination of accidents. (2) In case of accidents, the subsequences of which can threaten the health and safety of persons outside the construction site, the constructor or the technical manager shall immediately advise the

#	Subject	Law	Link	Content (English)
				respective civil protection office.
12	Environmental audit requirements	Law of preservation of environment(Article 148)	http://lex.bg/laws/ldoc/2135458102	Art. 148. (1) The Ministry of Environment and Waters shall implement control over the components of environment and the factors, which influence them. (2) The control shall be preventive, current and follow-up. (3) (amend. – SG 52/08) The control shall be implemented at national level by the Minister of Environment and Waters or by individuals, authorized by him, and at regional level – by the directors of RIEW, the directors of the basin directorates, the directors of the national parks, the regional governors and the mayors of the municipalities or officials, authorized by them.
13	Environmental	Law of preservatio	http://lex.bg/laws/ldoc	Chapter 6: Describes the needed assessment relating to environmental issues for a proposal, program or plan to begin.

#	Subject	Law	Link	Content (English)
	permits required for wind farms	n of environment(Chapter 6- Ecological assessment and environmental impact assessment) ; Chapter 7 (Article 104-106; Article 117))	/2135458102	Art. 104. (1) (Amended - SG. 77 of 2005, amended. - SG. 32 of 2012, effective 01.01.2013). The construction and operation of new and operation of a going concern and/or equipment classified as "enterprise and / or facility upper tier" is made after the issuance of a permit under the terms and conditions of this section. (2) (Amended - SG. 77 2005) permit under par. 1 is mandatory for the issuance of a Construction permit. (3) (New - SG. 77 2005) permit under par. 1 is unlimited. (4) (Prev. 3 am. - SG. 77 of 2005, amended. - SG. 32 of 2012, effective 01.01.2013) Para 1 shall not apply in cases under Art. 103, para. 5. (5) (Prev. 4 - SG. 77 2005, suppl. - SG . 32 of 2012 , in force from 01.01.2013) In case of change of operator of high risk potential new operator - a legal or natural person shall assume the rights and obligations under the permit. (New - SG . 77 2005) The Council of Ministers shall adopt an ordinance to prevent major accidents involving dangerous substances and to limit their consequences. The Minister of Environment and Water or a person authorized by him shall be the competent authority issuance, revision, amendment and revocation of permits under Art. 104, para. 1. Art. 106. (Amended - SG. 77 of 2005, amended. - SG. 32 of 2012, in force from 01.01.2013) In the permit under art.104, para.1 the Minister of Environment and Water shall determine conditions relating to the construction and operation of the enterprise and/or facility. Art. 117. (1) The construction and operation of new and operation of existing plants and facilities for categories of industrial activities listed in Annex № 4 shall be permitted after the issuance of a comprehensive permit under the provisions of this chapter. (2) (Amended - SG. 77 2005) The requirement under par.1 applies to the significant change of the existing plants and facilities. (3) (*) (revoked - SG. 32 of 2012, in force from 01.07.2014) (4) In case of change of operator new operator - a legal or natural person shall assume the rights and obligations under the permit.

#	Subject	Law	Link	Content (English)
14	Epoxy paint repairs on-site	Ordinance on № 7 of 23 September 1999 on the minimum health and safety of workers at workplaces and the use of work equipment. (Art.18, 20) Ordinance no 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementing construction and mounting works (Art2, 47)	http://www.lex.bg/bg/laws/ldoc/2135489147 http://www.lex.bg/bg/laws/ldoc/2135484004	Art. 18. (1) (prev. text of Art. 18 - SG . 43 of 2003) It is not allowed to exceed the established norms for production microclimate, noise, vibration, dust, toxic substances, lighting, non-ionizing and laser radiation in workplaces and workplaces. (2) (New - SG. 43 of 2003, amended. - SG. 40 2008) Workers should not be exposed under any circumstances due to increased risks of working in confined spaces. (3) (New - SG. 40 of 2008) For working in confined spaces provide a continuous surveillance outside and take all appropriate measures to provide effective and immediate assistance. (...) Art. 20. Processes and activities with the release of dust, toxic and other harmful substances, noise and vibration than the established norm presence of ionizing radiation, infrared radiation, ultraviolet radiation, lasers, electromagnetic fields, overheating microclimate wet processes, etc. organized in separate buildings or premises in compliance with the respective type of business regulations to ensure the health and safety and fire safety. Appendix № 5 to Art. 2, para. 2(Amended and supplemented. - SG. 102 of 2006) Performance of insulation and finishing works Art. 47. (1) (new - SG. 102 of 2006) In work places in confined spaces where air can become flammable or it can contain toxic or hazardous substances, or when there is not enough oxygen, the air must kept under control, and take appropriate measures to prevent hazards.

#	Subject	Law	Link	Content (English)
15	Escort cars for WTG carriers onshore	ORDINANCE № 11 of 3 July 2001, for the movement of oversized and / or heavy road transport means (amended, Art. - SG. 67 2007) (Article 11 para. 1-7; Article 12 (para. 32); Chapter VI)	http://www.lex.bg/bg/laws/ldoc/-549157888	The drivers are responsible for the movement and the escort of the heavy HVGs. They must: 1) provide the necessary signal warning for the heavy RTM and the necessary documents for the performance of the transport. 2) to check the distribution and safety of the consolidated cargo. 3) to appoint the transport to drivers who hold a driving license for the specific category, with an experience as a driver of category C of at least 5 years. 4) to introduce the driver with the special properties of the load and the specific requirements in his carriage, with which he is obliged to comply. 5) to remove at his own cost all the damages caused to the road, travel accessories and equipment, and other damage caused by them during the performance of the transport if he fails to meet the conditions specified in the authorization and regulation, or pay the costs for their recovery. 6) to award assistance for a person who meets the requirements of Art. 24. 7) to check the compliance of the actual dimensions of the RTM and the dimensions specified at the permit. When an escorting car is needed in accordance to Art. 10, para 1, they must pass over bridges at a safe speed, without stopping and without using the brake. Summary of the Chapter VI: The driver of the escorting car must have at least 5 year experience in the field (category B), must be familiarized with the regulations, acts etc. related to the escort requirements, safety on the road, and signals as specified in the Law for movement on the Road, must know English, French or German, must be familiarized with and follow the route and the conditions for movement of the RTMs, must check the dimensions of the RTM with permitted dimensions.

#	Subject	Law	Link	Content (English)
16	Escort requirements for oversized WTG components	Ordinance № 11 of 3 July 2001, for the movement of oversized and / or heavy road transport means (amended, Art. - SG. 7/ 2011) (Article 10 (para.1-2))	http://www.rta.government.bg/images/Image/n_uredba/N_11.pdf	The use of HVGs with a mass greater than 60t, or with at least one dimension greater than the dimensions permitted under Article 5, must have a permission as specified by Art. 8, para. 2, and be escorted as specified under chapter VI. The administration which controls the roads and the relevant department of control of the MoI can request an escorting vehicle for HVGs with dimensions smaller than the maximum allowed once if they consider the HVGs as a threat to the traffic. The administration which issues the traffic permits can request 2 or more escorting vehicles when: i) when the cargo is carried out on 2 side lanes (at difficult road conditions, with a lane width less than 6,00m, with an intensive transport (4000vehicles/day) ii) when the mass of the heavy vehicle and its load is more than 74t, iii) when the transport is done by 2 or more heavy vehicles).

#	Subject	Law	Link	Content (English)
17	Fire fighting equipment	Ordinance Iз-№ 2377 of 15 September 2011 on safety rules and standards for fire safety in the operation of facilities and sites (Art.5, 8) Ordinance № Iз-1971 of 29 October 2009 for construction technical rules and standards for ensuring fire safety (Art.3) Ordinance № 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementi	http://www.lex.bg/bg/laws/ldoc/2135755579 http://lex.bg/bg/laws/ldoc/2135653786 http://www.lex.bg/bg/laws/ldoc/2135484002	Art. 5 . (Amended - SG . 30 of 2013) Owners or managers of the establishments responsible for: 1. Making arrangements for the provision of DB objects and in accordance with the requirements of this Ordinance ; 2. maintenance of objects in working condition so as to conform to the construction documents; 3. during operation of the sites do not violate regulations and technical specifications applicable at the time of authorization of their use ; 4. maintain in good order , carrying out checks and maintenance , recharging and hydrostatic testing of pressure resistance of fire extinguishers in accordance with Art . 21 and 23 ; 5. maintenance and servicing of fire alarm systems (GIS) , fire extinguishing systems (PGS) , valves and fire control systems, smoke and heat of the sites in accordance with Art. 22 ; 6. provide the required fire equipment under Art. 15 copies of the declarations under Art . 8 Section 2 of Ordinance № Ih - 1543 of 2012 for authorization and control activities of the products with respect to fire extinguishing their effectiveness (SG . 59 of 2012); 7. marking of fire hydrants , fire extinguishers and access roads to them, fire equipment , fire hydrants, fire stairs and rescue operations , device alarm or disclosure of manually operated IPR and civil engineering , evacuation routes and exits and entrances to the premises of prohibited places for smoking and use of open fire, tanks of flammable liquids (highly flammable) , flammable liquids (GT) and combustible gases (GG) and the storage of materials and products in accordance with the requirements of art. 18, para . 2, art. 23 , para . 3 and 4 , Art. 24 , art. 25 , para . 2 , art. 42 , para . 2 , art. 48, para . 1 and Art. 62 , paragraph 2; Art. 8 . (1) objects creates a file containing at least the following documents: 1. documents under Art. 9 relating to the provision of DB object ; 2. (Amended - SG . 30 of 2013) protocols for the performance of maintenance, recharging or hydrostatic testing of pressure resistance of fire extinguishers (in combination or separately) in accordance with Annex № 8 of art. 40 , para . 6 of Ordinance № Iz - 2815 from 2011 on the procedures for implementing the authorization and control activities of traders, carrying out fire safety facilities and / or operation of machinery and equipment related to fire safety (SG . 91 2011) , and other evidence of maintenance and servicing of IPR civil

#	Subject	Law	Link	Content (English)
		ng construction and mounting works (Section V- Fire Safety (Title amend. - SG 102/06)) (Art. 69, 70)		engineering , valves and fire control systems, smoke and heat according to Art. 21 and 22 ; 3. coordination , and administrative penal prescriptive documents issued by the authorities for fire safety and protection of the population (PBZN) ; 4. instructions for operation and upkeep provided active protection measures (civil engineering , GIS , devices and equipment for evacuation and smoke control , etc. .) (...) 8. (new - SG . 30 2013) copies of declarations under Art . 8 Section 2 of Ordinance № Ih - 1543 of 2012 for authorization and control activities of fire-fighting products in terms of their extinguishing efficiency. Art. 3. (1) Depending on the functional fire safety of buildings designed fire alarm and sprinkler system with automatic and / or manual activation in accordance with Annex № 1. (2) (Amended - SG. 75 2013) The construction works according to their functional fire hazard shall be equipped with firefighting equipment in accordance with Annex № 2. Art. 69. (1) Fire board is equipped with handy tools and equipment according to the specifics of the site . (2) handy extinguishing equipment on site : 1. (Amended - SG . 102 of 2006) shall be assigned to persons designated by the technical manager to be responsible for PD, which are assigned the control and responsibility for the maintenance and enforcement status of life of these appliances and equipment; 2. periodically checked by the foreman , and the results are recorded in a special register ; 3. not used for commercial , industrial and other purposes not related to the fire . Art. 70. (1) Until the online tools, equipment for fire- hydrants and hydrants , buildings , warehouses and facilities on site to ensure uninterrupted access . (2) the equipment and facilities at par. 1 are marked with the signs and kept fit for use in winter conditions. (3) is not allowed leaving and storage of materials , parts, equipment, machines and more. , And parking of equipment and vehicles on the roads and approaches to the fire apparatus , equipment and

#	Subject	Law	Link	Content (English)
				installations for fire and
18	Fire fighting training	Ordinance Iз-№ 2377 of 15 September 2011 on safety rules and standards for fire safety in the operation of facilities and sites. (Art. 5	http://www.lex.bg/bg/laws/ldoc/2135755579 http://www.lex.bg/bg/laws/l	Art. 5 . (Amended - SG . 30 of 2013) Owners or managers of the establishments responsible for protection for each employee with adequate training and/or briefing on safety and health at work in compliance with the Ordinance № RD -07- 2 2009 on the conditions and procedures for conducting periodic training and instruction to employees on the rules for ensure healthy and safe working conditions (SG. 102 of 2009); ********* Section II. Training in health and safety at work Art. 5 . Training on health and safety at work aims to: 1. Absorption methods, forms and means of carrying out health and

#	Subject	Law	Link	Content (English)
		.) Ordinance № RD 07-2 of 16 December 2009 on the conditions and procedure for conducting periodical training and instruction for employees in the rules for ensuring health and safety at work (Art.5, 8, 9, 10) Ordinance № 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementing construction and mounting	doc/21356553 09 http:// www.lex.bg/bg /laws/l doc/21354840 02	safety at work; 2. Utilization of basic laws and regulations, norms, rules and measures to ensure safe and healthy working conditions; 3. Maintain the required level of knowledge and skills of employees in health and safety at work throughout the period in their careers in accordance with the requirements of theirs professions. Art. 8.(1) The training in health and safety at work is conducted by: 1. Employers in compliance with the ordinance; 2. Legal or natural persons registered under the Commercial Law under the Cooperatives Act or Law for Non-profit whose purpose is to set training; 3. Universities, vocational schools, high schools or colleges and vocational training centers; 4. Specialized bodies of the Ministry of Interior. (2) The training on safety and health at work is carried out by people with degree not lower than "bachelor" under the Higher Education Act, possessing professional knowledge and experience in the field of health and safety at work, as a collective agreement can be determined and other specific requirements for individuals. Art. 9. (1 Training of safety and health at work is documented in a manner specified by the employer. (2) (Amended - SG . 25 2010) Documentation relating to the conduct of training and Induction on safety and health at work, be kept by the employer for a period not less than five years and certifies conditions of art. 7 and 8. Section III. Instruction on safety and health at work. Art. 10. (1) Instruction on health and safety at work aims to give employees guidance on the safe performance of work, and to introduce them to specific conditions. (2) Instruction on safety and health at work is conducted: 1. on recruitment; 2. transfer to another job or a job change; 3. when introducing new or changing work equipment and technology; 4. periodically to maintain and supplement the knowledge of the employees on safety and health at work. (3) Instruction on safety and health at work are:

#	Subject	Law	Link	Content (English)
		works (Section V- Fire Safety (Title amend. - SG 102/06)) (Art. 65-71)		1. starting; 2. in the workplace; 3. periodic; 4. daily; 5. out of ordinary. ***************** Art. 65. (1) (Amended - SG. 102 of 2006), the construction site is categorized by means of signs and signals in accordance with the regulations. (2) a prominent place on the construction site is a signpost : 1. (Amended - SG . 102 of 2006) the telephone number of the local fire departments and protection of the population; 2. address and telephone number of the local medical service; 3. address and telephone number of the local rescue service . (3) (Amended - SG. 102 2006) inflammable materials and flammable liquids stored on site in offices and warehouses that meet the legal requirements for DB. Art. 66. (Amended - SG . 102 of 2006) (1) for the establishment of DB within the site builder : 1. Develop and approve instructions: a) safe execution of fire-works and other fire activities , incl. areas and places of work; b) fire-safe use of heating, electric heating and other electrical appliances; c) providing overtime; 2. Order that: a) the appointment of part-time firefighting commission; b) determination of permitted smoking areas; 3. Monitor compliance with the requirements for the prevention and eradication of fire and the evacuation of workers and those in the fire zone faces. (2) In carrying out construction works on site to service shall comply with the rules and norms of authority. (3) In case of fire or accident involving subsequent fires, builder or technical manager immediately notify the local authority. (...) Art. 67a (Amended - SG. 102 2006) Smoking is allowed only in areas designated by the order of Art. 66, para. 1, item 2, letter "b" , marked with appropriate signs or plates and fitted with non-combustible containers with water or sand.

#	Subject	Law	Link	Content (English)
				Art. 68. Internal fire hydrants sites and buildings in operation, which is a separate building site is located at accessible locations equipped with hoses and nozzles and enclosed in sealed boxes. Art. 69. (1) Fire board is equipped with handy tools and equipment according to the specifics of the site . (2) handy extinguishing equipment on site : 1. (Amended - SG . 102 of 2006) shall be assigned to persons designated by the technical manager to be responsible for fire-fighting, which are assigned the control and responsibility for the maintenance and enforcement status of life of these appliances and equipment; 2. periodically checked by the foreman, and the results are recorded in a special register ; 3. not used for commercial, industrial and other purposes not related to the fire. Art. 70. (1) Until the online tools, equipment for fire- hydrants and hydrants, buildings, warehouses and facilities on site to ensure uninterrupted access. (2) the equipment and facilities at par. 1 are marked with the signs and kept fit for use in winter conditions. (3) is not allowed leaving and storage of materials, parts, equipment, machines and parking of equipment and vehicles on the roads and near to the fire apparatus, equipment and installations for fire detection and suppression. Art. 71. (Amended - SG. 102 2006) When working with building products emit fire or explosive vapors, gases or dusts, not allow smoking, use of open flames or fire on heating devices, vehicles without spark arrestors on tools at work may be sparks, and electrical equipment and work equipment whose level of protection does not correspond to the class of fire or explosion hazard zone in the room or outdoor facilities. Art. 72. (Amended - SG . 102 of 2006) shall not be allowed: 1. use of non-standard heating and heating appliances and equipment and other combustion devices; 2. saving in construction machinery and near oxygen tanks of flammable, combustible, fire and explosives in containers, quantities

#	Subject	Law	Link	Content (English)
				and in a manner contrary to the requirements of the statutory requirements. 3. supply , use and storage on the construction site of flammable and combustible liquids, unless the necessary conditions for this in accordance with the relevant statutory requirements and manufacturer's instructions; 4. lighting of open fires regardless of the weather conditions and the part of the day, and smoking in areas classified or designated as a fire or explosion hazard; 5. heating of internal combustion engines on construction equipment, as well as frozen plumbing, sewer and other pipelines, open fire, electric heating appliances, etc.; 6. suspension of clothes, towels and other flammable materials on contacts, insulators and other parts of electrical installations and drying them on a radiator or heating appliances; 7. the use of paper, cardboard , fabric or other combustible materials for making lampshades for lighting.
19	First aid facilities and first aiders	Ordinance № 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementing construction and mounting works (Article 10; Article 16, para.1 (q-r)))	http://www.lex.bg/bg/laws/ldoc/2135484002	Art. 10. the plan for safety and health shall contain: 16. scheme and kind of the signalization for disaster, average, fire or accident, with defined place for rendering first aid. (...) Art. 16. The constructor shall ensure: q) (amend. – SG 102/06) provision of at any time first aid to the employees in case of occupational accident, fire, disaster or casualty, by trained persons; r) (new – SG 102/06) transportation of employees, affected by an occupational accident or in suddenly worsened health condition for rendering medical assistance.

#	Subject	Law	Link	Content (English)
20	General site development regulation	Law of the Spatial Planning(Art .10-13) Ordinance № 7 of 22 December 2003 for rules and regulations of spatial different types of territories and development zones(Chapter 14, 15) (Article 60-61)	http://pravo5.ciela.net/Document.aspx?id=2135458995&category=normi&lang=en-GB&Edition=63 http://www.lex.bg/bg/laws/ldoc/2135476546	Art. 10 . (1) (Amended - SG . 82 of 2012 , effective 26.11.2012) The requirements for the development of the territories shall be determined by concepts and schemes for spatial development and spatial plans in accordance with current regulations . (2) (Amended - SG . 82 of 2012 , effective as of 26/11/2012) Areas with special territorial protection, including areas with specific characteristics defined under separate laws can acquire a special regime drive and control. Scope and the device shall be determined by concepts and schemes for spatial development and spatial plans . (3) (Amended - SG . 82 of 2012 , in force from 26.11.2012) In the territories and parts thereof, of certain concepts and schemes for spatial development and spatial plans can be established mode preventive territorial defense , which preserves their actual use without degrading their quality. Art. 11 . (Suppl. - SG . 65 2003) In order to ensure appropriate device landed properties can be grouped in areas and development zones , which are determined by the general and detailed plans and in accordance with the ordinance of art . 13 , para . 1. Art. 12. (1) Building up the meaning of this law is the location and construction of buildings , structures, networks and facilities in the land . (2) Building up shall be allowed only if it is provided by an effective development plan after a change of land use , where this is required under the special law. (3) (Amended - SG . 65 2003) No change of use in lots of art. 8 , items 2, 3 and 4 allow construction of objects whose functions are compatible with the intended use of the property, in compliance with existing regulations and on the basis of a detailed plan or design visa issued by the chief architect of the municipality. Art. 13. (1) (Amended - SG . 66 of 2013 , effective 07.26.2013) The Minister of Regional Development and the Minister of Investment Design issue a regulation on the rules and norms of the different types of areas and development zones . (2) (Amended - SG . 65 of 2003, amended . - SG . 61 of 2007 , in force from 27.07.2007) Specific rules and regulations with which deviations from rules and regulations under par. 1 can be created to the general and detailed plans for territories or parts thereof: 1. with special territorial protection and preventive territorial protection under Art. 10, para . 2 and 3; 2 . for low-rise residential construction in settlements with complex

#	Subject	Law	Link	Content (English)
				terrain and geological conditions and / or low rise social housing ; 3 . for special projects related to defense and security. (6) (New - SG . 65 of 2004, amended . - SG . 19 of 2009 , effective 10.04.2009 , amended . - SG . 92 2009 with effect from 20.11.2009 , amended . - SG . 82 of 2012 , effective 26.11.2012) For protected areas for the conservation of cultural heritage specific rules and regulations to development plans or their changes are made , if the coordination of the assignment to design a development plan in accordance with Art . 125 , para . 6 Minister of Culture has set mandatory requirements for volume- spatial , architectural styles and construction of the proposed development plan for individual territories Group property or separate property within the boundaries of a single or group of immovable cultural property or their protected areas who require admission deviations from rules and regulations established by the ordinance under par. 1.
21	Grid connection regulations	Law of the Energy Sector (Connection of producers and consumers to the networks. Access to the networks) (Art.39, 82, 83, 84, 116, 117) Ordinance No 6, Incorporation of producers and users of electrical	http://lex.bg/laws/ldoc/2135475623 http://www.lex.bg/bg/laws/ldoc/2135506117	Art. 39. (1) The activities subject to licensing under this law are: 1. production of electric and/or heat power 5. trade with electric power; 6. organizing of market of electric power; 7. public supply of electric power or natural gas; Art. 82. (1) All electricity facilities in the country to connect and operate on a single power system with common mode and a continuous process of production, transformation, transmission, distribution and consumption of electricity. (2) (Amended - SG. 54 of 2012, effective 17.07.2012) The electric power system covers energy facilities producing electricity grid, the individual grids and electrical installations to clients. Art. 83. (1) (Amended - SG . 54 of 2012 , effective 17.07.2012) The structure and operation of the power system in accordance with standards set out in : 1. ordinance of electrical installations and power lines, which regulates technical standards for design and construction of electrical devices and power lines ; 2 . ordinance on the operation of power plants and networks , which regulates the terms and procedures for the organization and the technical operation of power plants and networks, power plants for electricity and / or heat , heating networks , of hydraulic structures of power plants and their mechanical parts (and the management and operation of power plants and networks) ;

#	Subject	Law	Link	Content (English)
		power to the state grid(Art.2, 176, 177)		Art. 116. (Amended - SG. 54 of 2012, in force from 17.07.2012) (1) The operator of the grid , the operator of the distribution network is required to connect any power producer located of the territory for which the manufacturer . 1. has entered into a written contract to join a connection fee determined under the relevant ordinance under Art. 36, para. 3; 2. fulfilled their contractual obligations under items 1 and regulatory requirements for accession to the electricity or the electric grid; 3 . Has electrical equipment within their own property or the property, he has the right to build matching technical standards and safety requirements, and 4 . has contracted for access under Art. 84, para . 2. Art. 117. (Amended - SG. 54 of 2012, in force from 17.07.2012) (1) The operator of the grid , the operator of the distribution network is required to connect any customer of electricity located of the territory, which: 1. Has electrical equipment within the property, meeting the technical standards and safety requirements; 2. Fulfilled the criteria for accession to the transmission or distribution network, and 3. has entered into a written agreement to join with TSO , by the operator of the distribution network , in connection price determined under the relevant ordinance under Art. 36, para. 3. Art. 177. (1) Owners or operators provide the durability and effectiveness of the use of facilities and equipment under Art. 2 during the operation, as well as environmental protection. (2) During the operation of objects of art. 2 organize continuous and periodic monitoring of the state of energy systems and networks in accordance with the requirements of Ordinance № 9 of 2004 on the operation of power plants and networks of Ordinance № 4 2004 for the operation of power and the legislative safety regulations .

#	Subject	Law	Link	Content (English)
22	Hazardous waste storage and disposal	Ordinance for the requirements for treatment and transport of production and dangerous wastes (Art.17, 18) Regulation on the treatment and transportation of waste oil and waste petroleum products (Art. 3, 5)	http://www.lex.bg/bg/laws/ldoc/-549700606 http://www.lex.bg/bg/laws/ldoc/2135512576	Section III. Temporary preservation of the wastes Art. 17. (1) The temporary preservation of production and dangerous wastes shall represent an activity connected with the storage for not more than 6 months. (2) The temporary preservation of production and dangerous wastes and the connected with them intermediary operations shall be implemented by the owner of the wastes on his territory. Art. 18. The owner of the wastes that are kept in temporary preservation locations, shall be obliged to ensure their disposal or handing over to persons with permission for this activity till the elapse of the term of art. 17, para 1. ****** Art. 3 . (1) waste oils priority is recovered by regeneration where technical , economic and organizational conditions allow . (2) If the conditions under par. 1 do not allow waste oils to regenerate , they are burned with energy recovery . (3) If the conditions under par. 1 do not allow the regeneration of waste oils or burning them in accordance with par. 2 then provides temporary storage and transfer for disposal. (...) Art. 5 . Following is prohibited: 1. disposal of waste oils and oil products in surface and ground waters , territorial sea and drainage systems; 2. storage and / or disposal of waste oils and petroleum products , leading to soil contamination; 3. treatment , including incineration of waste oils and petroleum products , leading to exceeding the established limit values of pollutants in ambient air; 4. illegal dumping of waste generated by the conduct of treatment and transportation of waste oils and oil products; 5. transfer of waste oils and petroleum products to persons not authorized under Art. 37 WMA or integrated permit issued under Chapter Seven, Section II of the EPA; 6. mixing of waste oils and other petroleum waste, which will hinder their recovery; 7. mixing of waste oils and petroleum fuel , coolant, brake fluid, solvents and other substances and materials; 8. disposal of waste oils and petroleum products in containers for

#	Subject	Law	Link	Content (English)
				collection of waste; 9. performance of waste oils change in places that are not equipped for the purpose and in containers complying with the regulatory requirements; 10. disposal of waste oils and liquid waste oil.
23	Health check-ups	Ordinance № 3 of 28.02.1987 on the preliminary and periodic mandatory medical examinations of workers (Art. 9, 10, 11)	http://www.lex.bg/bg/laws/ldoc/-552853504	Art. 8. Mandatory periodic medical examinations of workers are performed in order to diagnose the early forms of the disease and detection of risk factors for the occurrence of widespread and socially significant diseases. These reviews include the elements listed in Annex № 5. Art. 9. (1) mandatory periodic medical examinations are subject to all workers throughout the duration of their employment , as follows: 1. 18 years - every year; 2 . (Amended - SG . 102 of 1994) of 18 - to 40 - years old - every five years; 3 . (Amended - SG . 102 of 1994) over 40 years of age - a time of three years . (2) (Repealed - SG . 102 of 1994)

#	Subject	Law	Link	Content (English)
				Art. 10 . Workers in contact with industrial hazards subject to mandatory periodic medical examinations and procedures of Section III.
24	Health Check-ups prior to Assignment/Regular Check-ups	Ordinance № 3 of 28.02.1987 on the preliminary and periodic mandatory medical examinations of workers (Art.1, 2, 3, 8, 9, 10)	http://lex.bg/bg/laws/ldoc/-552853504	Art. 1. Mandatory preliminary medical examinations are carried out in order to give judgment on the suitability of persons with regard to their health status to perform a specific job (post production activities) for which you apply , appear on the preliminary medical examination (Annex № 1). Art. 2 . (1) of a preliminary medical examination shall be: 1. persons who are employed for the first time; 2. those who switched to another job in the same or another undertaking , which is related to hazards and risk of occupational injuries; 3. persons who cease employment for more than three months. (2) joining the industries and occupations listed in the industries and occupations in which mandatory preliminary and periodic medical check-ups of workers to hazards and deadlines for their implementation (Annex № 2), subject to prior review by medical specialists according to the list of medical specialists participating in the conduct of preliminary and periodic examinations for workers hazards and the necessary studies (Annex № 3). Art. 3 (1) Preliminary medical examinations of people entering work performed by physician employment (workshop doctor) and specialists from health care institutions serving businesses of employment. (2) (Amended - SG. 65 1991) If not now served by prophylactic institution of employment prior medical examination carried out by precinct therapists and specialists from health care institutions of residence of the persons or of medical specialists working in private and cooperative health facilities. (3) In the absence of necessary specialists and for making some

#	Subject	Law	Link	Content (English)
				clinical and para-clinical studies, subjects were referred for investigation by the established order to the relevant or specialized multidisciplinary medical- prophylactic institutions . Art. 8. Mandatory periodic medical examinations of workers are performed in order to diagnose the early forms of the disease and detection of risk factors for the occurrence of widespread and socially significant diseases. These reviews include the elements listed in Annex № 5. Art. 9. (1) mandatory periodic medical examinations are subject to all workers throughout the duration of their employment, as follows: 1. 18 years - every year; 2 . (Amended - SG . 102 of 1994) of 18 - to 40 - years old - every five years; 3 . (Amended - SG . 102 of 1994) over 40 years of age - a time of three years . (2) (Repealed - SG . 102 of 1994) Art. 10. Workers in contact with industrial hazards subject to mandatory periodic medical examinations and procedures of Section III.
25	High Voltage Regulations (competent personal, switching ops.)	Rules for Safety and Health at Work in electrical installations of electrical and heating plants and power grids (Title amend. - SG. 19 2005) (Art.7, 9, 10, 18, 19, 52, 53, 101, 219, 222, 243, 244, 249)	http://www.lex.bg/bg/laws/ldoc/2135483644 http://www.lex.bg/bg/laws/ldoc/2135506117 http://www.lex.bg/bg/laws/l	Art. 7. (1) Personnel who manage, supervise or perform work / activities of technical and operational maintenance of electrical systems and networks: 1. have education and experience required for the position held ; 2. a medical certification under the regulations of mandatory preliminary and periodic medical examinations of employees; 3. has a qualifying group for work safety in electrical systems and networks required by these Rules. Art. 9. (1) The required qualification group must be recorded in the job description. Art. 10. (1) The acquisition of qualifying person must possess the required qualification group for the education and experience in electrical systems / networks, has undergone training and exam. (2) Possession of a qualification group is proved by a standard certificate, which must be worn at work. Art. 18. (1) Upon completion of works existing electrical systems and networks of staff outside company responsible for the training and

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		Ordinance № 14 of 15 June 2005 laying down the technical rules and standards for design, construction and use of sites and facilities for generation, transformation, transmission and distribution of electricity (Art.176) Ordinance 3/9.06.2004 for the devices for the electrical installations and electrical lines(Art.1, 8, 9, 2111-2117)	doc/2135493680	qualification of personnel safety at work is the employer of the company. (2) The organization of training and verification of knowledge and skills of staff in these regulations is the responsibility of the employer company. Art. 19. (1) Every member of staff of the company holds a certificate of qualification group safety at work required under these Rules , brings him at work and on request submit it to the officer authorized by the employer - the owner of the site and control authorities. (2) Where it is established that the staff person of foreign company does not have the necessary qualification group for the job or the certificate has expired, it is not allowed to work. Art. 52. (1) Responsible for safety are: 1. issuing detail or order; 2. manager responsible for the work; 3. issuing a permit for the preparation and commencement of work; 4. of the preparation / safety in the workplace (protection); 5. admission to employment ; 6. contractor for the work; 7. monitored; 8. members of the brigade. (2) carry out training in the workplace (safety) and access to work may be the same person. Art. 53. (1) Persons who may issue a detail or order shall be determined by order of the employer. The employer establishes a list of people who can perform the duties of executive officer and Observer. Art. 101. (1) Samples include electrical switchgear / power line or a section of it during the work shall be subject to: 1. removal of the brigade from the workplace ; 2 . download portable earthing , weather signs , signs, fences , locks and installing permanent signs, signs, fences, operational/operational and maintenance personnel; 3. back on duty by the contractor on the work of the operating personnel formed daily completion of the work - in systems with permanent staff on duty . (2) The restoration work after trial inclusion shall be subject to the

#	Subject	Law	Link	Content (English)
				procedures and requirements for initial admission to work in the presence of the responsible manager and documented in costumes. (3) Sample inclusion and subsequent shutdown is performed by operational staff. (4) Test voltage switching in search of faults in switchgear (OC) without operating personnel and transmission lines is done at the request of the responsible manager / executive to work with the permission of the manager. Art. 219. Operational maintenance of electrical systems / networks perform shift duty or home by specially trained personnel. Art. 222. (1) Operational maintenance of electrical systems / networks is done by: 1. operational staff on duty; 2. operational and maintenance personnel in electrical devices without operating personnel and electrical networks. (2) Operational services are provided solely or in groups. (3) The number and composition of the operational staff in the change shall be determined by the employer with an internal instruction. Art. 243. (1) Operating switches in electrical systems with constant duty is performed by operational staff on duty serving systems. (2) For systems without staff on duty switching is performed by operational and maintenance staff (crew) who were assigned systems. (3) The right to carry out pre- operational inclusions in systems with voltages above 1000 V are the persons under par. 2 with five qualifying group included in a list approved by the employer. Art. 244. (1) In the orders that are given to individuals for performing operational switches is the sequence of operations. (2) The order is fulfilled only after receiving confirmation from the person who has been ordered. Art. 249. (1) Operating switches in RI with a voltage of 1000 V is carried out: 1. form without switching - if locking devices, which exclude irregular operations disconnections and grounding devices during their shift, and at times without particular difficulty; 2. to form the switching - in the absence or failure of the brakes , as

#	Subject	Law	Link	Content (English)
				well as for complicated switching operations, with the sheet switching and transferred over an annexation of the one bus system to another, irrespective of whether the state of the latches . (2) permitted complicated often repetitive operational switches be made in advance based on the model form for switching . (3) The list of complex operational switches made in forms, and procedures for their implementation shall be approved by the employer or his authorized officer. Art. 176. (1) Owners or operators of facilities and equipment under Art. 2 exploit them after receiving permission to use or a certificate of commissioning and after an initial technical review of high-risk facilities by the technical supervision. (2) High-risk equipment and facilities to objects of art. 2 is manned by qualified personnel have certificates. Art. 1. The ordinance regulates the structure of the electrical systems and power lines AC and DC voltages up to 750 kV, associated with the technology of the activity, the criteria for the selection of equipment and technical means of exploitation. Art. 8. The electrical systems are structured and equip facilities, technical equipment and materials in accordance with the standards and specifications in the contracts with the manufacturer. Art. 9. Design, construction , methods of deployment, class and characteristics of the machines, apparatus, measuring devices , protection and automation , cables and wires correspond to the parameters of electrical systems and networks , operating mode , environmental conditions and requirements of this ordinance. Art. 2113. Electrical equipment in electrical installations and networks accepted into service with a transmitter- receiver tests. Art. 2114. Transmission and acceptance tests for each facility shall be drawn up which contains at least: 1. type and number of the facility ; 2. country and manufacturing company ; 3. basic technical data; 4. inventory and characteristics of the measurement equipment; 5. results of the tests / measurements; 6 families and signatures of the persons conducting the test /measurement;

#	Subject	Law	Link	Content (English)
				7. conclusion to date. Art. 2115. For electrical equipment not covered by those specified in this chapter transceiver acceptance tests are performed according to factory instructions or the appropriate standard. Art. 2116. (1) Electrical machinery and equipment for voltages up to 35 kV must be tested with high voltage , the values of which are specified in the technical conditions of supply. (2) In the presence of test devices for higher voltages of 35 kV High-voltage test is also mandatory. (3) Several interconnected electrical equipment be tested with voltage standards for the facility with the lowest test voltage. Art. 2117. Transmission and acceptance tests of relay protection devices and equipment are carried out in accordance with the project and the factory instructions.
26	Hoist/Lifting Devices - Permits	Regulations for safe running and Technical Supervision of lifting equipment (Art.2, 3, 4, 5, 54, 55, 100) Most of articles are relevant	http://www.lex.bg/bg/laws/ldoc/2135696084	Art. 2 . (1) This Ordinance shall apply to the following lifting equipment : 1. cranes; 2 . electric hoisting trolleys running on overhead tracks that are not mounted cranes ; 3 . hoists that are not mounted cranes ; 4 . excavators designed to work with the hook, grab or electromagnet; 5 . lifting accessories; 6 . hanging baskets for lifting persons; 7 . Mobile Workstations; 8 . construction and other hoists for lifting persons or persons and goods which fall within the scope of the Ordinance on the essential requirements and conformity assessment of machinery , adopted by Decree № 140 of the Council of Ministers of 2008 (promulgated, SG . 61 2008 corr . No. 71 of 2008 , as amended. amended and supplemented. No.48 of 2010), regardless of the date of manufacture and legislation determining their organization, which has been in force the date of their manufacture. (2) This Ordinance shall apply to the tracks to facilities under par. 1, items 1-3 and 7. Art. 3 . This Ordinance shall not apply to:

#	Subject	Law	Link	Content (English)
				1. lifting equipment , which are plant and machinery under Art. 2 , para . 2, items 2-10 of the Ordinance on the essential requirements and conformity assessment of machinery ; 2. lifting equipment used in the production of films; 3. elevators *within* the meaning of § 1, item 1 of the Supplementary Provisions of the Ordinance on the essential requirements and conformity assessment of lifts and their safety devices adopted by Decree № 242 of the Council of Ministers of 2001 (promulgated, SG . 94 2001 , as amended. amended and supplemented . No.87 and 115 of 2002, No.100 of 2003 pcs. 24 and 40 , 2006, issue 37 of 2007 and No.61 2008), and the operation of which the Regulations for the safe operation and technical supervision of elevators adopted by Decree № 75 of the Council of Ministers of 2003 (promulgated, SG. 33 of 2003, amended . and supplemented. No15 and 96 of 2005, No. 40 and 70 , 2006, issue 64 of 2008 and No.32 of 2009); 4. construction and other hoists for goods only; 5. small freight elevators; 6. hoists for persons or persons and goods with a maximum lifting height up to 3 m; 7. hoists for persons or persons and goods, moving along a path close to the railing of the stairs and designed to tackle the stairs; 8. industrial trucks; 9. lifting equipment mounted on tractors; 10. winches; 11. lifts connected to machinery and intended exclusively for access to jobs; 12. escalators. Art. 4. Lifting equipment under Art. 2, para. 1, items 1-4 and 7 are located or installed in accordance with instructions. Art. 5. (1) jib cranes designed for construction and assembly works of art. 2 , para . 1 of Decree № 2 of 2004 on the minimum health and safety conditions in the course of construction works (SG.37 of 2004), shall be placed on the site in accordance with project should contain: 1. requirements for capacity , height , range and other technical characteristics of the cranes that will be used; 2. safe distances from cranes to overhead power lines to the

#	Subject	Law	Link	Content (English)
				locations of movement of vehicles or pedestrians to existing buildings and facilities to build and to places of storage of goods; 3. precautions for installation and operation of cranes near steep slopes and excavations and work of two or more taps of an object; 4. requirements for lifting accessories to be used graphical schemes suspension of cargo location of transport routes and places for the storage of goods; 5. situation construction plan; 6. measures and requirements to ensure safe operation of cranes in execution of construction and installation works ; 7. copy of an order of the user taps down the makers of art. 55 , item 1; 8. scheme locations for cranes ; 9. scheme of landing sites , handling and storage of cargo cranes or to conduct them ; 10. scheme to supply electricity of cranes when they are powered by electricity; 11. plan and schedule for the work of the temporary lighting of the construction site at the places specified in Item 8 and 9 - for cranes, which will be operated in the nighttime . (2) placement of jib cranes mounted on vehicles or self-propelled or self-propelled chassis, which will be installed or removed equipment or facilities of less than 80 percent of the maximum capacity of the crane for the load profile can be done without a draft under par.1. Art. 54. (1) The user must allow the operation of lifting equipment only when they comply with the essential requirements is attested by a declaration of conformity and CE marked in accordance with applicable regulations of the facilities under Art. 7 LTRP. (2) The user and the persons who manage lifting equipment must comply with the instructions . Art. 55 . The user of the lifting equipment is required to: 1. designate one or more persons to be responsible for the safe operation of the equipment and to represent the technical surveillance authorities, this requirement does not apply to facilities located in residential buildings; 2. ensure the management of lifting equipment under Art. 2 , para .1, item 1, 4 and 7 only drivers who have the appropriate level of competence pursuant to Ordinance № 1 of 2002 on terms and conditions for the acquisition and recognition of qualifications for

#	Subject	Law	Link	Content (English)
				occupations management of Cranes and Mobile Workstations (prom. , SG . No. 28 of 2002, as amended and supplemented . No. 39 of 2006), or trained in accordance with paragraph 3 persons; 3. establish order and to provide training to persons who manage lifting equipment under Art. 2, para .1, item 2 and 3, as well as persons who manage cranes and mobile work sites for the management of not requiring licenses under Ordinance № 1 of 2002 on the terms and conditions for the acquisition and recognition of legal capacity professions management of cranes and mobile workstations; procedures and training must be documented; Art. 100 . (1) Users of lifting equipment are required after installation of static or moving by rail facilities or acquisition of portable equipment , but before putting into service must register with the authorities for technical supervision. (2) Users of lifting equipment subject to technical supervision by Art. 97, item 1, are required to register with the regional departments of DG "TI" in whose territory they are installed, and non-stationary facilities - the regional department whose territory will be operated during most of the year. (3) Users of lifting equipment subject to technical supervision by Art. 97, paragraph 2 shall be obliged to register with the elected bodies.
27	HSE training needs (working at heights etc.)	Ordinance № RD 07-2 of 16 December 2009 on the conditions and procedure for conducting periodical training and instruction for employees in the rules for ensuring health and	http://www.lex.bg/bg/laws/ldoc/2135655309 http://www.lex.bg/bg/laws/ldoc/-549670400	Section II. Training in health and safety at work Art. 5. Training on health and safety at work aims to: 1. absorption methods, forms and means of carrying out health and safety at work; 2 . utilization of basic laws and regulations, norms, rules and measures to safe and healthy working conditions; 3. maintain the required level of knowledge and skills in health and safety at work of employees throughout the period in their careers in accordance with the requirements of the profession. Art. 8. The training in health and safety at work is conducted by: 1. employers in compliance with the ordinance; 2. legal or natural persons registered under the Commercial Law under the Cooperatives Act or Law for Non -profit whose purpose is to set training; 3. universities, vocational schools, high schools or colleges and vocational training centers;

#	Subject	Law	Link	Content (English)
		safety at work (Section II, Section III) Ordinance № 7 of September 23, 1999 for the minimal requirements for healthy and safe conditions of work at the working places and in using the working equipment (Art.3) Ordinance no 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementing construction and mounting works		4. specialized bodies of the Ministry of Interior. The training on safety and health at work is carried out by people with degree not lower than "bachelor" under the Higher Education Act, possessing professional knowledge and experience in the field of health and safety at work, as a collective agreement can be determined and other specific requirements for individuals. Art. 9. Training of safety and health at work is documented in a manner specified by the employer. (Amended - SG. 25 2010) Documentation relating to the conduct of training and instruction on safety and health at work, be kept by the employer for a period not less than five years and certifies conditions of art. 7 and 8. Section III. Instruction on safety and health at work Art. 10. (1) Instruction on health and safety at work aims to give employees guidance on the safe performance of work , and to introduce them to specific conditions. Instruction on safety and health at work is conducted: 1. on recruitment ; 2. transfer to another job or a job change ; 3. when introducing new or changing work equipment and technology ; 4. periodically to maintain and supplement the knowledge of the employees on safety and health at work. (3) Instruction on safety and health at work are: 1. starting; 2. in the workplace; 3. periodic; 4. daily; 5. extraordinary. ************** Art. 3. (Amended - SG . 88 2004 , in force from 05.11.2004) In addition to the obligations under the HSWA employer: 1. (suppl. - SG. 43 2003 , suppl. - SG. 40 2008) inform the workers and/or their representatives on health and safety at work of all measures related to safety and protection health, which are to be undertaken in the workplace and the use of work equipment. The information should be easily understood by workers concerned; (suppl. - SG. 40 of 2008) in consultation with workers and/or their representatives on health and safety at work and an opportunity for

#	Subject	Law	Link	Content (English)
		(Article 19-20)		their participation in all matters related to this ordinance. Art. 19. (1) The instructions for safety and health shall contain: 1. the rights, the obligations and the responsibilities of the persons, who manage or guide the respective labor processes; 2. the required legal competence or qualification of the workers for implementing construction works for defined construction technologies and of the operators of construction machinery and instruments; 3. the requirements for HSLC: a) before starting, during and upon stopping, termination and finishing of the work; b) for use of the respective construction machines and the other working equipment; c) at making trials and checks for functionality of technological equipment and installations; 4. (suppl. – SG 102/06) a list of resources for collective protection and the personal protection aids, necessary for fulfilment of the work, giving priority to the collective before the personal; 5. (new – SG 102/06) rules of storage, keeping and application of the used products and items; 6. the conditions for compulsory and emergency termination of work, measures for rendering first aid to the injured upon accident etc.; 7. (amend. – SG 102/06) scheme for placing of the signs for safety of labor and fire safety (FS) and of the places for placing the descriptions of the signals, made with hand, and of the verbal messages, which upon need are made at work. 8. (prev. item 5 – SG 102/06) other requirements, connected with the concrete conditions of work; The instructions of para 1: 1. shall be put at accessible and visible places in the working zone; 2. shall be updated at any change and contain the dates, on which are approved and changed. Art. 20. The instructions for safety and health at electricity facilities and working equipment shall include also the issues about: 1. the way of hanging of cables with length over 3 m and minimum suspension 2.5 m; 2. safeguarding against damages from electric currency of the used electrified wagons, barracks, containers etc. according to the instruction for exploitation;

#	Subject	Law	Link	Content (English)
				3. the periodicity of the check of the electric safeguarding, including also by measurements; 4. marking the existence of voltage and the power of the used contacts and extensions; 5. the use of portable transformers, lamps and electric appliances and instruments; 6. the check of the effectiveness of the lightning protection in case such is required.
28	Inspection and maintenance of fire alarm and lifts	Ordinance Iz-№ 2377 Safety rules and standards for fire safety in the operation of facilities Regulations for safe running and Technical Supervision of lifting equipment SG. No. 73 of 17 September 2010. amend. and supplemented. SG. 103 of 28 December 2012. amend. SG. No 24 of 12 March 2013.	http://www.lex.bg/bg/laws/ldoc/2135755579 http://www.lex.bg/bg/laws/ldoc/2135696084	Art. 22. (1) The maintenance and servicing of fire alarms and lifts carried out in accordance with the operating instructions of the manufacturer and in compliance with the following standards: 1. for fire alarm systems - SD CEN / TS 54-14 " Fire alarm systems. Part 14 : Guidelines for planning, design, installation, commissioning, operation and maintenance"; 2. for automatic sprinkler installations - Item 20 of BS EN 12845" Fixed firefighting systems. Automatic sprinklers. Designing, installation and maintenance"; 3. for fixed fire-fighting systems with dust - BS EN 12416-2 " Fixed firefighting systems . Installations with dust. Part 2: Design, construction and maintenance"; 4. for fixed fire-fighting installations gases - BS EN 15004-1 " Fixed firefighting systems . Installations for gas extinguishing systems. Part 1: Design , installation and maintenance (ISO 14520-1:2006, as amended)"; 5. for fixed fire-fighting foam systems - BDS EN 13565-2 " Fixed firefighting systems . Installations foam. Part 2: Design, construction and maintenance"; 6. for fixed fire-fighting installations condensed aerosols - SD CEN / TR 15276-2 " Fixed firefighting systems . Extinguishing systems with condensed aerosols. Part 2: Design , installation and maintenance"; 7. for fixed fire-fighting installations with water spray jet - SD CEN / TS 14816 " Fixed firefighting systems . plants with water spray. Designing , installation and maintenance." (2) Fire valves are maintained in accordance with the operating instructions of the manufacturer and in accordance with the requirements of BS EN 671-3 "Fixed firefighting systems. Systems with a hose. Part 3: Maintenance of hose reels with semi-rigid systems and flat hose." (3) The management of smoke and heat are maintained in

#	Subject	Law	Link	Content (English)
				accordance with the operating instructions of the manufacturer and in accordance with the requirements of BS EN 12101 " Management Systems smoke and heat." (4) (New - SG . 30 2013) The maintenance and servicing of fire alarm civil engineering and control systems, smoke and heat, designed in accordance with Art.7 of Ordinance № Is -1971 2009 for building technical rules and standards for ensuring fire safety are carried out and subject to the specific requirements of the standard or the national legislative act in which they are designed. (5) (prev.4, suppl. - SG. 30 2013) The maintenance and servicing of fire alarm and civil engineering, the hydrants and control systems, smoke and heat are performed by dealers authorized to carrying out this activity under the ordinance. 91F, para. 6 LMI. Activities, for which the standards do not require competence for their implementation, can be carried out by those who create the organization and supervise compliance with the rules and regulations on the site.

#	Subject	Law	Link	Content (English)
29	Inspection and maintenance requirements for electrical components	Ordinance no 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementing construction and mounting works (Article 20; Article 80-81) Ordinance № 7 of September 23, 1999 for the minimal requirements for healthy and safe conditions of work at the working places and in using the working equipment Ordinance of the essential	http://www.lex.bg/bg/laws/ldoc/2135484002 http://lex.bg/laws/ldoc/2135592478 http://lex.bg/laws/ldoc/2135581768	Art. 20. The instructions for health and safety at exploitation of electric facilities and working equipment shall include also issues about: 1. the way of hanging of cables with length over 3 m and minimum suspension 2.5 m; 2. safeguarding against damages from electric currency of the used electrified wagons, barracks, containers etc. according to the instruction for exploitation; 3. the periodicity of the check of the electric safeguarding, including also by measurements; 4. marking the existence of voltage and the power of the used contacts and extensions; 5. the use of portable transformers, lamps and electric appliances and instruments; 6. the check of the effectiveness of the lightning protection in case such is required. (...) Art. 80. (1) (amend. – SG 102/06) Construction machines and motor vehicles shall be admitted to work close to electric power lines when the distance between the imaginary vertical surfaces, formed by the nearest part of the machine or the load and the most external line of the electric power line, is bigger than the distances, pointed out in table 1: (2) (amend. and suppl. – SG 102/06) At the places, determined for passing of construction machines at the construction site, located under electric power lines boards shall be put, indicating the voltage and the smallest dimensional height of the conductors related to the terrain. ******** Section V. Electric installations and equipment Art. 46. (1) (prev. art. 46, amend. SG 88/04; amend. - SG 40/08) The electric and electricity distribution installations and equipment shall be designed and worked out in such a way so that at using them no dangers of fire or explosions are caused. The exposed working persons must be protected in appropriate way from risk of injuries from electricity from direct or indirect contact. (2) (new – SG 88/04) The designing, working out and the choice of materials and protective devices and protection means must be complied with the electric voltage, the conditions of the ambience

#	Subject	Law	Link	Content (English)
		requirements and conformity assessment of machinery Ordinance № 16-116 of 8 February 2008 on the operation of power equipment (Art. 73, 75)		and the competence of the persons, who have access to the installation and its component parts. Art. 47. (1) The designing and working out of the electric installations and equipment and the choice of the materials and safety devices used for them shall be complied with the type and the volume of the electric voltage and the conditions of operation. (2) The electric installations and equipment shall be serviced by persons with the necessary qualification and capacity. ********* Art. 73. (1) The employer shall arrange for maintenance, scheduled and unscheduled repairs, modernization and reconstruction of power equipment. (2) The employer shall provide necessary under par.1: 1. funds repair documentation, special tools and fixtures; 2. spare parts and materials for maintenance and repairs; 3. system of quality assurance; 4. prepare a plan agreed with the territorial authorities for fire and rescue. (..) Art. 75. (1) The maintenance and scheduled repairs will be made in a form and amount as to maintain in good and working condition of power equipment, taking into account the actual state changing employment conditions and periodic restorations. (2) planned maintenance schedules are developed - annual , quarterly and monthly. (3) The frequency of repairs is determined according to the technical condition of the equipment with the regulations and instructions of the manufacturers and the system adopted for repair. (4) The duration of repairs is determined according to the type of repair and production Art. 274. (1) Periodic inspections include: 1. visual inspection of the visible parts of the grounding system; 2. regard to the integrity of the grounding circuit between ground and bond equipment and removal of bad breaks and contacts; 3. inspection of the connection of portable earthing stationary electrical installations; 4. light of mark grounding, earthing and protective conductors and

#	Subject	Law	Link	Content (English)
				protective earthing terminals; 5. check the grounding system of the compounds with natural and artificial grounding; 6. measuring the grounding resistance to ground; 7. measuring the resistance of the neutral wire to ground - in networks with directly earthed star point, which uses zeroing; 8. check of the drilling fuses; 9. check the degree of corrosion present in the ground elements of the grounding system by digging.

#	Subject	Law	Link	Content (English)
30	Lifting equipment inspections after installation (Operation , inspection and maintenance requirements for tool lifts, man lifts, and other safety equipment in WTG)	Regulations for safe running and Technical Supervision of lifting equipment SG. No. 73 of 17 September 2010. amend. and supplemented. SG. 103 of 28 December 2012. amend. SG. No 24 of 12 March 2013. (Art. 108, 109, 110) Ordinance no 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementing construction and mounting	http://www.lex.bg/bg/laws/ldoc/2135696084 http://lex.bg/bg/laws/ldoc/2135653786	Art. 108. (1) The technical surveillance carried out following the technical inspection of the registered lifting equipment: 1. initial - after the first registration; 2. periodic: a) lifting equipment under Art. 2, items 1-4 and 6-8 - two years since the last technical inspection of item 1-8 , and if the lifting equipment art. 2, para.1, item 1 is operated for more than 16 years - one year since the last technical review section 1-8 b) lifting accessories that are not part of the art facility. 2, para.1, item 1-4 - 12 months after the last technical review conducted under item 1-8; periodic with static and dynamic testing - of hoisting equipment under Art.2, para.1, items 1-4 and 7-4 years after the last technical inspection carried out under items 1, 3-7; 4. after reconstruction; 5. when not operated for more than one year; 6. after replacement or repair of: a) bearing structures, load- lifting mechanism , hoisting hooks or roller blocks - for lifting equipment under Art. 2, para.1, items 1-5 and 7; b) lifting mechanism, bearing ropes and accessories for their suspension, the speed limiter or catchers - for lifting equipment under Art. 2, para.1, item 8; 7. after removal and installation of another workstation - for stationary or moved on rails lifting equipment under Art.2, para.1, items 1-3 and stationary mounted lifting equipment under Art.2 , para.1, 7 and 8; 8. at the request of the lifting equipment; (2) To carry out technical inspections under par.1, item 1-8 users of lifting equipment are required to submit a written application to the technical supervision over who have registered facilities. Tests are carried out in two weeks of receipt of the application - for examination under par.1, item 1, 4-7; 2. six weeks of receipt of the application - for examination under par.1, item 2, 3 and 8. (3) The dates for carrying out technical inspections under par.1, items 1-8 in terms of para. 2 are determined by the technical supervision and notified at least 5 days in advance of the user of the equipment. (7) The tests are carried out in the presence of the person under Art.55 item 1 and/or support person lifting facility. (8) The period under par.1, item 2, letter "b" the last day of the

#	Subject	Law	Link	Content (English)
		works (Article 16,para.1(g))		twelfth month following the month of the previous review and the terms of para.1, item 2, letter "a" and 3 expire on the last day of the second , fourth , respectively , from the year preceding the year of review. (9) After each technical inspection authority under Art.97, item 2 placed on lifting equipment art.2, para.1, item 1-4 , 6-8 near the nameplate sticker on which are recorded the registration number of the body conducting the technical review , the registration number of the hoist or the date of the review and the year to be perform the following periodic review. The sticker must be securely fastened and markings should be clearly legible and indelible. Art. 109. The user is obliged to provide the employees of government authority all required equipment for the inspection including apparatus, instruments, control weight, electricity, qualified staff and personal protective equipment. Art. 110. (1) Upon initial technical review is carried out: 1. check for the presence of the CE conformity with the essential requirements of the Ordinance on the essential requirements and conformity assessment of machinery - when required; 2. check compliance with the hoist or the documents under Art. 101, para.2 or 3; 3. check for compliance with the requirements of Chapter Two; 4. external review of the unit and functional testing of the mechanisms, electrical safety components and hydraulic system; 5. static test; 6. dynamic test; 7. check compliance with the lifting gear with art.101, para. 5 and 6 in the cases. 101, par.4. (2) Upon initial examination of lifting equipment that are marketed assembled , do not make static and dynamic test if it is more than 24 months from the date of issue of the declaration of conformity under Art. 101, para. 2, item 3 . Art. 16. The constructor shall: 1. ensure: g) (amend. – SG 102/06) indexing and accounting of the implemented checks, trials, technical maintenance and repairs of the facilities and the working equipment (the electric and the lifting facilities, the construction machinery, the motor vehicles etc.) and their permanent control with regard to removal of defects, which can

#	Subject	Law	Link	Content (English)
				affect the safety or the health of the workers.
31	Manual handling	Ordinance № 16 of 31.05.1999 on the physiological norms and rules for manual-handling of weights (Art.3, 4, 6) Ordinance № 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions	http://www.lex.bg/bg/laws/ldoc/-549687806 http://www.lex.bg/bg/laws/ldoc/2135484002	Art. 3. The employer shall take appropriate organizational measures or ensure the use of appropriate techniques and equipment to avoid manual handling of loads. Art. 4. In all cases where the manual handling of loads cannot be avoided, the employer shall: 1. take the necessary organizational measures to reduce the manual handling of loads; 2. provides providing workers appropriate technical means; 3. organize work so that manual handling of loads to be minimal risk to the health and safest ; 4. provide for an evaluation (possibly prior) risk to health and safety performance of the work specified in that Annex indicators; 5. take the necessary measures to prevent or reduce the risk, taking into account the indicators listed in the Annex. Art. 6. (1) The employer shall provide the workers performing manual handling of loads and/or their representatives information about: 1. all taken under the provisions of this ordinance measures to ensure healthy and safe working conditions; 2. general characteristics of the cargo in accordance with the application and, if possible, accurate information about:

#	Subject	Law	Link	Content (English)
		at implementing construction and mounting works (Article 56,para.2; Article 63, para.2		a) the weight of the load; b) the center of gravity or the heaviest side when a package is eccentrically located in the package; c) the specific requirements arising from the nature of the cargo. (2) The employer shall provide the workers with training and instruction on the proper method of manual handling of loads, including lifting, moving, carrying, placing, unloading, sorting of different types of weights, and information on the risks they face if working with weights not run correctly. (3) (Amended - SG . 70 2005) The employer shall consult workers and/or their representatives and to create conditions for their participation in all matters relating to the implementation of the ordinance, in accordance with the health and safety at Work. Art. 56. The sheet-pile coffers and the caissons shall: 1. be constructed and mounted only under the control of a consultant; 2. be made of appropriate material with sufficient strength; 3. be ensured with appropriate facility so that the workers to be able to rescue upon penetration or water or material; 4. be controlled at intervals and by a person, determined by the constructor. Art. 63. (1) The lifting and descending to and from height of any kind of loads (construction products, shutter elements, instruments etc.) shall be done primarily in mechanized way. (2) Manual performing of the works of para 1 by throwing, load shifting from hand to hand or with the help of ropes, wires, reinforcing steel etc. shall not be admitted.

#	Subject	Law	Link	Content (English)
32	Noise restrictions (applies to installation of offshore foundations, WTGs and operation of WTGs)	Law of protection from noise in environment (Art 16, 25) Ordinance № 7 of September 23, 1999 for the minimal requirements for healthy and safe conditions of work at the working places and in using the working equipment (Art.18, 20)	http://www.lex.bg/bg/laws/ldoc/2135510077 http://www.lex.bg/bg/laws/ldoc/-549670400	Art. 16. Legal persons and sole traders: 1. operate in a manner that avoids causing environmental noise above the limits established by the ordinance under Art. 11, item 5; 2. Owners of systems and equipment for categories of industrial activities listed in Annex № 4 to Art. 117, para. 1 of the Environmental Protection conduct self-monitoring and provide information to the Regional Inspectorates of Environment and Water for their sound emissions into the environment; 3. cooperate with the competent authorities under this Act in the course of verification. Art. 25. Preventive control is effected through the procedures for environmental assessment and environmental impact through the issuance of permits under the Act for the protection of the environment, as well as compliance procedures and authorization under the Health Act and the Law on Spatial territory. Art. 18. (1) (prev. text of Art. 18 - SG-43 of 2003) shall not be allowed to exceed the established norms for production microclimate, noise, vibration, dust, toxic substances , lighting, non-ionizing and laser radiation in workplaces and workplaces . (2) (New - SG . 43 of 2003, amended. - SG-40 2008) Workers should not be exposed under any circumstances due to increased risks of working in confined spaces. (3) (New - SG . 40 of 2008) For working in confined spaces provide a continuous surveillance outside and take all appropriate measures to provide effective and immediate assistance. Art. 20. Processes and activities with the release of dust, toxic and other harmful substances, noise and vibration than the established norm presence of ionizing radiation, infrared radiation, ultraviolet radiation, lasers, electromagnetic fields, overheating microclimate wet processes, etc. organized in separate buildings or premises in compliance with the respective type of business regulations to ensure the health and safety and fire safety .

#	Subject	Law	Link	Content (English)
33	Permits to carry hazardous chemicals and gases in the WTG service vans/ by suppliers.	Ordinance for the requirements for treatment and transport of production and dangerous wastes (Article 25-32).	http://www.lex.bg/bg/laws/ldoc/2135484002	Art. 24. Transportation of industrial and hazardous waste is carried out by producers of waste or only after signed transportation contract between the holder of the waste and the transporter. Art. 25. (1) At conceding dangerous wastes for transport they shall be considered as dangerous load and the transport process comes under the requirements of the international documents referring to transport of dangerous loads being with the power of internal legislation. (2) The requirements of para 1 shall be with respect to: 1. the packing of the load; 2. the transport - accompanying documents; 3. the kind and the designation of the transport means; 4. the admitting of the transport; 5. the restrictions; 6. the training of the staff etc. Art. 26. The load supplier shall be obliged to: 1. at transport of not dangerous production wastes: a) to submit to the carries certificate of the load; b) to use only fit packing; 2. at transport of dangerous wastes in addition to the requirements of para 1: a) to classify the dangerous wastes as dangerous load in compliance with the documents of art. 25; b) to be convinced that this dangerous load is admitted to transport with the provided transport means; c) to submit to the carrier full and true data and information as well as the following documents: "Account card for submitting, transport and receiving of dangerous wastes" according to Ordinance No 10 of 1998 for the order of registration of documents about the accounting and the information about the management of the activities with wastes (SG 151/98), "Written instructions about the activities at accidents" according to appendix No 5 and if necessary - permissions, certificates and other documents which to ensure the unimpeded conduct of the transport; d) to use only packing, means for bulk packing and containers which are admitted for transport of the corresponding dangerous waste; e) to mark and label the packs of item a) in compliance with the requirements of the normative acts of art. 25;

#	Subject	Law	Link	Content (English)
				f) to observe the prescriptions referring to the way of sending the load and the restrictions connected with the sending; g) to ensure for the carrier the personal protection means required in the instructions for activities at accidents of item c); h) to be convinced that the carrier has a permission under art. 37 and that a copy if it is in the transport means. Art. 27. If the load supplier is not the source of the dangerous waste its producer shall be obliged to concede to the load supplier full and true written information, data and documents about the dangerous waste necessary for the implementation of his obligations. Art. 28. Dangerous wastes admitted to transport shall be transported with technically fit specialized or universal transport means. Art. 29. Under the condition of concluded contract for transport the carrier shall have the right to refuse the transport if the entity of some of the vessels / packs is breached or their appearance does not comply with the prescriptions or the load does not conform with the announced in the transport document. Art. 30. The carrier shall be obliged: 1. to be convinced that the load supplier has submitted the transport accompanying documents in compliance with the prescribed form and content and that they are in the transport means; 2. to be convinced that the dangerous load is admitted to transport with the corresponding transport means; 3. to control about missing parts of the load; about empty or torn parts of the pack; about excess of the admissible maximum load of the transport means; 4. to mark, label and designate the transport means according to the requirements of the normative acts of art. 25; 5. next to the mark of item 4 for dangerous load (warning orange board) to put second board according to the model of appendix no 6, respectively: a) on the front and the back sides of the vehicle; b) on the two longitudinal sides of a carriage; 6. to ensure in the transport means: a) copy of the permission of art. 37; b) copy of the transport contract;

#	Subject	Law	Link	Content (English)
				c) the personal protection means for the crew necessary for activity in accident situation; 7. at accident discharge of load during the transport to act in compliance with the instructions for activities at accidents of art. 26, item 2, item c). Art. 31. The carrier shall bear responsibility in the sense of the concluded contract and for his obligations as participant in the transport process. Art. 32. The load supplier or the load receiver has to ensure, in case other has not been agreed, appropriate cleaning or inactivation of the transport means.

#	Subject	Law	Link	Content (English)
34	Plant and equipment use/maintenance	Ordinance № 7 of September 23, 1999 for the minimal requirements for healthy and safe conditions of work at the working places and in using the working equipment(Art.4, 10,) Ordinance of the essential requirements and conformity assessment of machinery(Art.2, 3, 106) Most of articles are relevant	/www.lex.bg/bg/laws/ldoc/-549670400 http://lex.bg/laws/ldoc/2135592478	Art. 4. In the organization and implementation of work to meet the requirements of this Ordinance, the relevant regulations on safety and health at work for various industries, activities, types of work and work equipment and fire safety. Art. 10. (Amended - SG. 24 2013) The owner or operator of an entity object or work equipment supports file containing all documents reflecting periodic tests and inspections during the operation, including repairs, as well as measurements of the state of the working environment, including the results of monitoring, where it is envisaged that. ******* Art. 2. (1) This regulation applies to: 1. machines; 2. attachments; 3. security features; 4. lifting accessories; 5. chains, ropes and webbing; 6. removable gear mechanical transmission torque; Art. 3. When the risks of equipment specified in the ordinance are wholly or partly covered by other legislation transposing EU directives, the provisions of these regulations in respect of such risks.

#	Subject	Law	Link	Content (English)
35	PPE Requirements	Ordinance № 3 of 19.04.2001 on the minimum requirements for health and safety of workers using personal protective equipment at work. (Art. 5-9, 13, 20-23)	http://www.lex.bg/bg/laws/ldoc/-549167616	Art. 5. (1) In dealing with the health and safety risk that cannot be eliminated otherwise the employer shall provide workers appropriate personal protective equipment. (2) For use of personal protective equipment meeting the requirements of this Ordinance, the general and specific legislation on safety and health at work for various industries, activities, types of work and work equipment and fire and emergency safety. (3) The enactments referred to in para. 2 contain cases, situations and circumstances in which an employer, although implemented with priority requirement for the collective protection measures must ensure the use of conformable with personal protective equipment. Art. 6. (Amended - SG. 40 2008) Personal protective equipment shall meet the standards and requirements for safety and health contained in the applicable personal protective equipment regulations related to the essential requirements for products that are designed for placing on the market and/or putting into service. Art. 7. Personal protective equipment must: 1. provide protection from risks, where applicable, without they themselves lead to an increase in any risk; 2. satisfy the conditions in the workplace ; 3. comply with requirements of ergonomic and health of workers; 4. match the size of the user of PPE, if necessary, after appropriate adjustment. Art. 8. Where in more than one hazard is necessary for workers to wear more than one personal protective equipment, they should be compatible when used together to continue to be effective against the hazards. Art. 9. Conditions for the use of personal protective equipment, especially the time that worn by employees shall be determined according to the work of any worker exposure, the degree of risk and the characteristics and effectiveness of personal protective equipment. Art. 13. The employer shall provide training to employees and organized demonstration on the use, storage, and how to check the condition of personal protective equipment.

#	Subject	Law	Link	Content (English)
				Art. 20. Personal protective equipment is used : 1. constantly - when dangers operate continuously; 2. periodically - when dangers arise in certain types and conditions of work; 3. emergency - in case of accidents, disasters, catastrophes and other similar circumstances. Art. 21. Facilities for storing personal protective equipment used for emergency shall be determined by the employer with the order. Art. 22. The employer shall provide a reserve of personal protective equipment necessary to ensure the safe performance of work. Art. 23. (1) The employer shall provide periodic quality checks of personal protective equipment. (2) The inspections shall be recorded.
36	Pressure Vessels Inspections after installation	Ordinance for the essential requirements and assessment of the compliance of the vessels under pressure (Art. 12) Rules for technical supervision high-risk facilities (Art.5, 12)	http://www.lex.bg/bg/laws/ldoc/2135593393 http://www.lex.bg/bg/laws/ldoc/-17002495	Art. 12. Pressure equipment must be designed and constructed so that it is possible to carry out all testing/inspection to ensure safety. ******* Art. 5 . Authorities state that technical supervision have the following rights and obligations: 1. supervise compliance with the statutory requirements of the technical devices and safe for humans and the environment functioning of the regulated businesses operating in the country; (...) 4. stop the operation of regulated facilities constructed or operated in violation of statutory requirements; 6. take action to impose administrative penalties for violations of the technical condition and proper functioning of the regulated objects under the Town and Country Planning Act and standardization; Art. 6. Authorities state that technical supervision have access at any time to the supervised entities. For special-purpose access is by an order consistent with the relevant ministries and other departments. Art. 12. Specialized bodies departmental technical supervision organizations and their divisions have the following rights and obligations:

#	Subject	Law	Link	Content (English)
				1. organize and supervise compliance with the regulations for the structure and functioning of the regulated entities; 2. registered and supervised Certification sites and carry out technical inspections of these facilities by the established order;
37	Service lifts, cranes (applies to man lifts and tool lifts in WTGs)	Regulations for safe running and Technical Supervision of lifting equipment SG. No. 73 of 17 September 2010. amend. and supplemented. SG. 103 of 28 December 2012. amend. SG.	http://www.lex.bg/bg/laws/ldoc/2135696084 http://lex.bg/laws/ldoc/-549143040 http://lex.bg/bg/laws/	Art. 54. (1) The user must allow the operation of lifting equipment only when they comply with the essential requirements is attested by a declaration of conformity and CE marked in accordance with applicable regulations of the facilities under Art. 7. (2) The user and the persons who manage lifting equipment must comply with the instructions. Art. 55. The user of the lifting equipment is required to: 1. designate one or more persons to be responsible for the safe operation of the equipment and to represent the technical surveillance authorities, this requirement does not apply to facilities located in residential buildings; 2. entrust the management of lifting equipment under Art. 2, para.1, item 1, 4 and 7 only drivers who have the appropriate level of competence pursuant to Ordinance № 1 of 2002 on terms and conditions for the acquisition and recognition of qualifications for occupations management of Cranes and Mobile Workstations or trained in accordance with paragraph 3 persons; 3 . establish order and to provide training to persons who manage

#	Subject	Law	Link	Content (English)
		No 24 of 12 March 2013. (Art.54,) Ordinance on the essential requirements and conformity assessment of lifts and their safety equipment (Art.2, 36, 37, 38) Ordinance no 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementing construction and mounting works (Article 38, 39, 56,)	ldoc/2135653786	lifting equipment under Art. 2, para.1, item 2 and 3, as well as persons who manage cranes and mobile work sites for the management of not requiring licenses under Ordinance № 1 of 2002 on the terms and conditions for the acquisition and recognition of legal capacity professions management of cranes and mobile workstations; procedures and training must be documented; 4. provide for the signature of the responsible persons under item 1 and the management and staff operating instructions of art.46, para.1, item 2; 5. ensure placement in the cabin of lifting equipment under Art. 2, para.1, item 8 instructions for use; 6. ensure that the maintenance, repair and reconstruction of lifting equipment is only performed by persons who are registered under art. 36, para.1 as persons engaged in such activities; 7. secure a written contract for the maintenance of lifting equipment under Art. 2, para.1, item, 4, 6 - 8 person entered in the register under Art. 3, para.1 and to prevent their operation when there is no such a treaty, this does not apply if the user himself is entered in the register under Art. 36, para.1 as a person who maintains such lifting equipment; 8. not to allow maintenance, repair and reconstruction of lifting equipment by persons who are not registered under art. 36 , para . 1 LTRP as persons engaged in such activities; 9. not to allow the repair of lifting equipment without documentation of art. 39, para.1 or if it is not certified in accordance with Art. 99; 10. prevent the installation of elevators without investment project or if the project is not certified in accordance with Art. 98; 12. prevent the deployment or installation of lifting equipment in violation of the requirements of Chapter Two; 13. not to allow to work with lifting equipment for staff who do not have adequate degree of competence pursuant to Ordinance № 1 of 2002 on terms and conditions for the acquisition and recognition of qualifications for occupations management of cranes and mobile workstations or not trained in accordance with paragraph 3; 14. not allowed to work with lifting equipment under Art. 2, para.1, 5 and 6 individuals who have not undergone instruction in art. 58, para.1 ; 15. prevent operation of lifting equipment, which are not registered with the authorities for technical supervision or not they carry out technical inspections of art. 108, para.1, items 1-7;

#	Subject	Law	Link	Content (English)
				16. prevent operation of lifting equipment when in the act of initial technical inspection or inspection certificate was entered the conclusion that the facility is not fit for safe operation. Art. 36. (1) (Amended - SG.100 of 2003) In addition to the data required for the marking in accordance with Part Two, Chapter One, Section VII "Indications" of the Ordinance on the essential requirements and conformity assessment machines, each booth must be easy to see a sign with the following data: 1. rated capacity in kilograms; 2. maximum number of passengers that can be carried. (2) The cab must have a clear and obvious instructions for evacuation if the lift is designed so that in the closed cabin passengers can be released without outside help. Art. 37. Protective devices must be accompanied by instructions in Bulgarian so that the installation, connection, setup and maintenance can be carried out effectively and safely. Art. 38. Each lift must be accompanied by documentation in Bulgarian, which include: 1. operating instructions containing drawings, schematics and other technical documents necessary for the proper use, maintenance, examinations and repair, and for periodic checks and rescue operations; 2. log, which records repairs and periodic inspections . Art. 38. (1) For safeguarding of the working equipment at the construction site shall be used permanent or temporary fences (parapets, covers, nets, screens etc.), applied at shafts, stairs, balconies, landings, bridges, trestles, pedestrian paths, protruding parts and parts with sharp edges and ends, moving machines and facilities, preparation of materials, splashing and pouring liquids, flying parts, metal shavings, filings etc. (2) The passes, the approaches and the entrances of the construction site, which are in the dangerous zones of the working equipment, shall be secured at not less than 1.0 m out of the their dimension with solid and stable covers (protecting floors, hoods etc.) according to the concrete conditions.

#	Subject	Law	Link	Content (English)
				Art 39. (1) The dangerous zones, where is possible falling of loads at movement with mounting crane, shall be signaled with warning signs and boards. In these zones shall be prohibited the access of external persons at least 5.0 m from the vertical of the lifted loads. (2) In case the dangerous zone of para 1 reaches the fence of the construction site, protection hood shall be constructed over it. (3) In case the dangerous zone of para 1 reaches out of the fence of the construction site or covers other construction facilities, the work in it shall be organised according to the plan of safety and health. (4) Lifting, movement or lowering of any kind of loads, mounting elements, equipment etc. over inhabited buildings in the dangerous zone of load lifting (mounting) facility shall not be admitted. Art. 56a. (new – SG 102/06) (1) In case of carrying out of load lifting operations with: 3. heavy large size components onto and from motor vehicles the employees shall have first to abandon them and to move away at a safety distance from them.
38	Incident reporting to authorities	Ordinance for the establishment, investigation, registration and account of labor accidents (Art. 2)	http://lex.bg/bg/laws_stoyan/ldoc/-549450238	Art. 2. (1) Concerning each labor accident the injured, his direct manager or the witnesses to the accident shall immediately inform the head of the insurer or the official authorized by him. (2) (amend. SG 19/02) Immediately after being informed of a labor accident the head of the insurer or the official authorized by him shall start an investigation into the circumstances of the accident. At the investigation shall obligatory be invited representatives of the workers and the employees from the committees and the groups for labor conditions and of the trade union Organization s at the enterprise. (3) (new – SG 19/02) A record shall be compiled about the results of the investigation, which must contain the data of art. 10, para 1, and attached to it shall be the written evidence of the witnesses of the accident. (4) (new – SG 19/02) A copy of the record shall be conceded to the territorial division of the National Insurance Institute (NII).

#	Subject	Law	Link	Content (English)
39	Medical check-ups	Ordinance № 3 of 28.02.1987 on the preliminary and periodic mandatory medical examinations of workers (Art. 9, 10, 11)	http://www.lex.bg/bg/laws/ldoc/-552853504	Art. 8 . Mandatory periodic medical examinations of workers are performed in order to diagnose the early forms of the disease and detection of risk factors for the occurrence of widespread and socially significant diseases. These reviews include the elements listed in Annex № 5 . Art. 9. (1) mandatory periodic medical examinations are subject to all workers throughout the duration of their employment, as follows: 1. 18 years - every year; 2 . (Amended - SG . 102 of 1994) of 18 - to 40 - years old - every five years; 3 . (Amended - SG . 102 of 1994) over 40 years of age - a time of three years . (2) (Repealed - SG . 102 of 1994) Art. 10. Workers in contact with industrial hazards subject to mandatory periodic medical examinations and procedures of Section III.
40	On-site welfare facilities	Ordinance № 11 of 21.12.2005 establishing the conditions and procedures for providing free food and / or supplements thereto (Арт. 2)	http://www.lex.bg/bg/laws/ldoc/2135514759	Art. 2. (1) The specific nature of the labor is provided free food and / or supplements thereto employees who work: 3. with average daily temperatures below +10°C and above +30°C in more than half of the maximum established by the Labor Code working hours; 6. under the influence of exposure above the established norms: carcinogens or mutagens silikozoopasen dust, heavy metals, organic solvents and biological agents, chemical agents, dust, noise and vibration in the production and transmission of electricity and heat, including repair services and transport technology.

#	Subject	Law	Link	Content (English)
41	Use of contractors	Ordinance no 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementing construction and mounting works (Art.18)		Art. 18. (1) Persons engaged in self-employment, and employers are personally engaged in work activity on the construction site shall comply with requirements of the regulation considering the guidelines of the coordinators for occupational health and safety. (2) A subcontractor coordinate their actions to ensure the health and safety with the developer who hired him.
42	Safety of WTG construction workers and service technicians	Law for healthy and safe labor conditions(Article 3 (para.1); Article 5) Ordinance no 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementi	http://www.lex.bg/bg/laws/ldoc/2135484002	Art. 3. (1) The assurance of occupational healthy and safety conditions shall be implemented according to the specific character of the accomplished activity and the requirements of the technical, technological and social development with objective protection of life, health and working capacity of the working persons. Art. 5. (1) Anyone designing construction sites and activities, production, facilities, technologies and working equipment shall be obliged to comply the design with all rules and standards for healthy and safe working conditions. (2) (amend.– SG 40/07) In the process of design, construction and entering into operation of the sites the consignor shall be responsible and require and the respective control bodies shall control the compliance with the rules and the standards for occupational health and safety conditions by the designer or the builder. Art. 26. The technical manager shall: 1. fulfil and control the observing of the requirements; 2. directly participate in the working out of the instructions for safety and health and manage and control their application; 3. observe the requirements for health and safety to the used

#	Subject	Law	Link	Content (English)
		ng construction and mounting works (Article 10; Section VI Actions in Case of Accidents (Article 26)		construction technologies and designs; 4. conduct instructions for health and safety of the workers, managed by him; 5. prohibit work with construction machinery, facilities and instruments, which do not meet the requirements for health and safety: 6. immediately notify his direct chiefs about misfortunes and/or accidents at the construction site, the construction, the part of the construction or the working places he is in charge of; 7. distribute the workers to working places according to their legal competence, qualifications, knowledge and experience; 8. control the following: a) the planning and the safe demolition of buildings and facilities by undertaking appropriate protection measures, methods and procedures; b) the mounting and dismounting of steel or concrete frames and their components, shudders, ready made construction elements or temporary supports and bearings; c) the correct arrangement and preservation at the construction site of the materials, the parts and the equipment; 9. ensure the following: a) termination of the work and take out all persons from the construction site, the construction or the respective working place when there is serious or immediate danger for their health or life or when there are conditions at which is required stopping the work; upon his absence from the construction site these obligations shall be fulfilled by persons with the necessary qualification, pointed out by him; b) order and hygiene at the working places and the construction sites he is in charge of; c) coordination of the work when the scaffolds, the platforms and the cradles are used by several brigades; 10. determine the following: a) the working zone and the boundaries of the dangerous zone at movement of construction machines and mechanization on the construction site; in the cases when the driver has no sufficient visibility the technical manager shall determine signalman with him; b) the places for fixing of the safety belts of the workers and the cradles, the platforms and the suspended stairs to a secure and strong support and everyday control the hanging appliances before

#	Subject	Law	Link	Content (English)
				starting work; c) person, who is to control the fitness, the correct exploitation, the checks, the maintenance and the repair of the working equipment (construction machinery, direct burning appliances etc.); d) person, who is to be in charge for the fitness, the correct use, the checks, the cleaning and the repair of the sanitary – service premises; 11. fulfil in time the prescriptions of the control bodies for health and safety; 12. participate at analysing the reasons for admitted labor accidents.
43	Requirements for on-site epoxy paint repairs	There are no specific regulations for on-site epoxy paint repair. However more information can be obtain from: Ordinance no 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementing construction and mounting works (Art.		Art. 47. (1) (new - SG . 102 of 2006) In work places in confined spaces where air can become flammable or it can contain toxic or hazardous substances, or when there is not enough oxygen, the air must kept under control, and take appropriate measures to prevent hazards.

#	Subject	Law	Link	Content (English)
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44	On-site welfare facilities	Ordinance no 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementing construction and mounting works (Article 14; 34-35)	/www.lex.bg/bg/laws/ldoc/-549670400	Art. 14. Before the opening of the construction site the assignor or the person, authorized by him, shall be obliged to guarantee with assessment of compliance by the order of the Law of spatial planning (LSP) that: 1. with the design of the construction are observed the requirements for safety for all stages of construction and that all installations (water supply, power supply, gas pipeline and other conduits, sewers etc.), being in the zone of the construction site, are clearly marked in the design; 2. the design of the construction is coordinated and approved by all interested bodies and persons; 3. any other changes in the design will be coordinated by the respective order without breaching the requirements of HSLC Art. 34. (1) The premises for warming and the places for instruction of the workers shall be furnished with benches, tables, medicine cabinets and stretchers for rendering first aid to the injured. (2) (amend. – SG 102/06) The kind of the heating, the way of air exchange and the accomplishment of the ventilation installations in the premises for change of clothing and rest must meet the sanitary – hygiene requirements and the requirements for FS. Art. 35. The sewerage system at the construction site must ensure taking out of the surface waters in order not to be admitted flooding of the roads, the paths, the passes, the railway lines, the sub-crane roads, the places for parking non-rail construction machines, the open storehouses, the loading and unloading plots etc.

#	Subject	Law	Link	Content (English)
45	Risk assessments/working instructions	Law for healthy and safe labor conditions (Article 4 (para.1-3)) Ordinance № 5 of 11.05.1999 on the order, method and frequency of risk assessment Ordinance № 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementing construction and mounting works(Article 15)	http://lex.bg/laws/ldoc/2134178305 http://lex.bg/bg/laws/ldoc/-549691391	Art. 4. (amend. – SG 40/07) (1) The employer shall be obliged to ensure healthy and safe labor conditions for the workers by applying the measures required, including: 1. professional risks prevention; 2. provision of information and training; 3. ensuring the necessary Organization and resources. (2) The employer shall comply the measures referred to in para 1 with the changing circumstances with the purpose of improvement of the present situation. (3) The employer shall apply the measures referred to in para 1 by ensuring the common prevention principles: 1. risk avoidance; 2. assessment of the risk which cannot be prevented; 3. risk limitation at the source of their origin; 4. adaptation of the work to the worker, especially with regards to the design of workplaces, the choice of work equipment, of work and production methods with the purpose of assuagement or elimination of monotonous work, the cycle with, as well reduction of their impact on the worker's health; 5. bringing in compliance with the technical progress; 6. replacement of the dangerous things with safe or less dangerous ones; 7. marking of the existing dangers and the sources of factors hazardous to health and safety. 8. application of consistent overall policy for prevention covering technology, work Organization , labor conditions, social relations and the impact of the elements of the working environment and the labor process; 9. use of the collective protection means with priority to the individual protection means; 10. giving respective instructions to workers. Art. 15. (1) before starting work on the construction site and till the finishing of the construction the constructor shall be obliged to make risk assessment. (2) The risk assessment shall cover all stages of the contracted construction, the selection of the working equipment and all parameters of the working environment. (3) The risk assessment shall be made together with the preliminary announced subcontractors and it shall be updated at the including of

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				new ones in the process of work. (4) At implementing CMW on the territory of a working enterprise the risk assessment shall be made together with ins manager. (5) If during the implementing of CMW essential changes of the initial plans occur, the risk assessment shall be updated. (6) At implementing of risk assessment measurements of the parameters of the working environment shall be made.
46	Safety signs - wind darm sites	Ordinance № RD-07/8 of 20 December 2008 on minimum requirements for signs and signals safety and / or health at work (Art. 5, 6, 10) Ordinance № 2 of march 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementing construction and mounting works. (Article 59	**Error! Hyperlink reference not valid.**	Art. 5 . (1) The employer shall post signs and signals of safety and / or health at work under this regulation in areas where risks cannot be prevented or reduced by means of collective protection or measures, methods or procedures of work organization . (2) Upon the placement of signs and signals for safety and / or health at work under par.1, the employer shall take into account the risk assessment in the workplace. (3) The employer is obliged to monitor the availability and functionality of the set signs and signals of safety and / or health. Art. 6 . (1) The employer shall provide appropriate training and instruction to workers about the types of signs and signals of safety and / or health at work, as well as terms and conditions for their use. (2) The training and instruction under par. 1 include the importance of signs and signals for safety and / or health at work, especially those that contain the words and the general and specific behavior in their use. Art. 10. (1) prohibitions, warnings, liabilities, and to determine evacuation routes, emergency exits and the location of first-aid use signs, general requirements set out in Annex № 2 . (2) signs on containers and pipes are placed in Annex № 3. (3) The location and identification of extinguishing technical means are indicated by signs and / or a safety color under Annexes № 1 , № 2 and № 4. (4) The locations where the risk of hitting a hurdle or fall shall be permanently marked with a safety color in Annex № 5 and / or signs in accordance with Annex № 2. (5) Transport routes shall be permanently marked with a safety color in Annex № 5. (...) Art. 59a. (new – SG 102/02) The signs, used on the construction site in compliance with the requirements of the Ordinance No. 4 of 1995 for the signs and signals for work safety and fire protection (SG

#	Subject	Law	Link	Content (English)
		(a); Article 57-59;Article 65) Ordinance № 7 of September 23, 1999 for the minimal requirements for healthy and safe conditions of work at the working places and in using the working equipment (Art.13, 15) Ordinance the essential requirements and conformity assessment of machinery (Art.152)		77/95) shall have to be placed steadily in appropriate places ********* Art. 57. (1) The use of construction machines and lifting facilities and installations (except tampers, vibrators and instruments) without fit sound and/or light signalization shall not be admitted. (2) Upon work with machines and facilities, creating dangerous zone warning signals shall be given. Art. 58. (1) Signals with hands and/or verbal communication shall be use in the cases when they are required for directing the workers, making risky or dangerous maneuvers. (2) The signalman shall use the movements of the hands (wrists) for directing the maneuvers or for indicating the way of maneuvering of a worker (operator, driver etc.), who receive the signals. (3) To the signalman shall be ensured opportunity to observe all maneuvers visually without being put at danger. When this condition is not fulfilled one or more signalmen shall be put additionally. Art. 59. (1) The signalman must carry one or more brightly colored subjects by which to be clearly detected by the operator and the other workers. (2) The operator shall stop the maneuvers and require new instructions when hi is not in capacity to fulfil the received ones observing the necessary requirements for security. Art. 65. (1) (amend. – SG 102/06) The territory of the construction site shall be categorized for fire safety and marked with signs and signals according to the normative requirements for fire safety. (2) At visible places at the construction site shall be put boards with: 1. (amend. – SG 102/06) the telephone number of the local service for Fire safety and population protection (FSPP); 2. the address and the telephone number of the local medical service; 3. the address and the telephone number of the local rescue service. (3) (amend. – SG 102/06) The fire hazardous and inflammable liquids shall be preserved at the construction site in premises and storehouses, meeting the normative requirements for fire safety. ******** Art. 13. (1) The roads on the premises and the transport arrangements comply with the nature of work, the use of vehicles

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				transporting goods and the requirements of this Ordinance. (2) roads within the enterprise is built and maintained permanent surface and marked with appropriate markings, traffic signs and signals. (...) Art. 15. Masts, antennas, chimneys, towers, buildings and other facilities, the height of which is a danger to aviation are signaled with light marking (*This regulation applies to MetMast and WTG*) (...) Art. 152. (2) signs and / or signs shall be designed, manufactured and selected so as to be clearly visible and indelible.

#	Subject	Law	Link	Content (English)
47	Safety Signs for WTG Shipments	Merchant Shipping Code (Title Amend. - SG 108/2006) (Article 72 (para.1-6))	http://www.marad.bg/upload/.../Merchant_Shipping_Code.doc	Art. 72. (amend. – SG 113/02) (1) A ship may not be put in operation, if it was found according to the relevant order by the Executive Agency "Maritime Administration", that she was not constructed, equipped and her crew meets the requirements for safety of shipping in terms of number and qualification. (2) The ship-owner shall be obliged to render assistance to the competent authorities and to undertake the necessary measures for safety, for environment protection from pollution by ships and for protection and recovery of the fish resources regarding the ship and the crew. (3) (new – SG 55/04; amend. – SG 87/05) The Minister of Transport shall determine in an ordinance the safety requirements regarding the different types of ships, their construction and ship equipment. (4) (prev. text of para 03 – SG 55/04) The ships and vessels, sailing the internal waters, the territorial sea and the adjacent zone of the Republic of Bulgaria shall be equipped with radio communication means approved by the Executive Agency "Maritime Administration" in compliance with the requirements for registration, equipment, assembling and usage of the radio equipment according to the Law of the Telecommunications. (5) (prev. text of para 04 – SG 55/04) The self-propelled ships, sailing the inland waterways, the small ships, the ferryboats and non-self-propelled vessels and devices shall be equipped with the respective ship radiotelephone stations for carrying out radio exchange within the range of the meter waves, approved by the Executive Agency "Maritime Administration". (6) (prev. text of para 05 – SG 55/04; amend. – SG 87/05) The conditions and order of equipment, registration and usage of the radiotelephone services in shipping on inland waterways shall be determined in an ordinance issued by the Minister of Transport in compliance with the regional agreement on radiotelephone services on the inland waterways.

#	Subject	Law	Link	Content (English)
48	Shackles maintenance and inspections	Ordinance on the essential requirements and conformity assessment of machinery (Art. 2, 184) Regulations for safe running and Technical Supervision of lifting equipment SG. No. 73 of 17 September 2010. amend. and supplemented. SG. 103 of 28 December 2012. amend. SG. No 24 of 12 March 2013.(Art.2, 56, 59, 61, 69, 71)	http://lex.bg/laws/ldoc/2135592478 http://www.lex.bg/bg/laws/ldoc/2135696086	Art. 2. (1) This regulation applies to lifting accessories. Art. 184. (1) The marking of lifting accessories include: 1. information on the material required for their safe use; 2. maximum load. (2) the case of accessories may not bear the CE mark under par. 1, it is applied to the plate or by other means and securely affixed to the accessory. (3) The information referred to in para.1 must be legible and located so that it cannot be deleted and delete the use of the device or to affect its strength . Art. 56. (1) The persons responsible for the safe operation of hoisting equipment under Art. 2 , para. 1, items 1-6 are required to prevent operation of lifting equipment if the check under item 5 found that : h) is the deadline for performing periodic inspections of lifting devices of the facility passed; i) lifting equipment or its load device is not registered with the Technical Surveillance Authority or where the order for initial review or assessment notice was entered the conclusion that the facility is not fit for safe operation; Art. 59. (1) Instructions for using lifting equipment under Art. 2, para.1, items 1-4 must be read in accordance to Art. 46, para.1, item 2 LTRP, setting the line lashing and suspension of cargo and used for the purpose of lifting accessories. (...) Art. 61. (1) The responsible persons under Art. 56, para. One should check the condition of lifting accessories each month and record the results of these checks in a diary. (2) Persons who manage the lifting equipment under Art. 2, para. 1, items 1-4 and shunters are required before starting work to verify the condition of lifting accessories. (3) Do not allow the use of faulty and non-weight and nature of the cargo lifting accessories. (...) Art.69. Persons operating lifting equipment under Art. 2, para. 1, items 1-4 and shunter must use slings with capacity corresponding to the weight of the load and angle between branches, not more than 90°. The use of straps with a larger angle between the branches,

#	Subject	Law	Link	Content (English)
				when it is marked thereon. (..) Art. 71. The user persons managing lifting equipment under Art. 2, para. 1, items 1-4 and shunter must use only lifting accessories on which permanently marked with their capacity.
49	Site permits needed (local, regional, national)	law of the Spatial Planning (Article7-9) (Site permits depend on the ownership of the property as specified in the Law of	http://pravo5.ciela.net/Document.aspx?id=2135458995&category=normi&lang=en-GB&Edi	Art. 7. (1) (prev. Art. 7, amend. – SG 82/12, in force from 6.11.2012; amend. and suppl. - SG 28/13) According to their basic designation defined with the concepts and spatial development schemes and general development plans the territories in the country are: urbanized territories (settlements and settlement formations), agricultural territories, forest territories, protected territories, damaged territories for restoration, territories covered by waters and water sites and transport territories. (2) (new – SG 82/12, in force from 6.11.2012) Territories intended for agricultural, forest or urbanized territories may be at the same time intended as protected territories, determined by a law. Art. 8. The concrete designation of the landed properties shall be determined with the detailed development plan and it can be:

#	Subject	Law	Link	Content (English)
		the spatial planning and after receiving an approval of the Detailed Zone Plan; Chapter eight. Investment designing and permission of construction) Energy from renewable sources Act (article 8)	tion=63 http://www.lex.bg/bg/laws/ldoc/2135728864	1. (amend. SG 65/03; amend. and suppl., SG 65/04) in urbanized territories or in separate landed properties out of them - for residential, public servicing, production, storage, resort, villa, sport and amusement functions, green areas and green connections between them and the territories of nature protection, for decorative water systems (cascades, navigation canals and others), for movement and transport, including bicycle lanes and for movement of disabilitiyped people, for technical infrastructure, for special sites etc. 2. in agricultural territories - for farmed land (fields, orchards and vegetable gardens, vineyards, meadows etc.) and non farmed land (pastures, slopes, gullies, ravines etc.); 3. in forest territories - for forests (timber woods, protective forests, recreation forests etc.) and forest lands (glades, land taken by bushes, rocks etc.) 4. (amend., SG 88/05) protected territories - for protection of environment (reserves, national parks, natural sites, maintained reserves, nature parks, protected areas, beaches, dunes, water sources with their sanitary - protection zones, water areas, humid zones, protected coastal strips) and for preservation of the sites of the culture and historic heritage (archaeological reserves, separate quarters or landed properties in settlements with culture-historic, ethnographic or architectural significance); 5. in damaged territories - for restoration and reclamation of quarries, mines, mounds, deposits, tailings ponds, waste deposits, land slides etc. 6. (new – SG 28/13) in territories covered by waters and water sites – for the internal sea waters and the territorial sea, the Bulgarian section of the Danube river, the rivers, lakes and dams; 7. (new – SG 28/13) in transport territories – for the republic and local roads, the railway infrastructure, the ports and airports. Art. 9. (amend. – SG 61/07, in force from 27.07.2007) (1) In territories without development plans the designation of land properties until the enforcement of the plans shall be determined on the grounds of their actual use, unless their use contravenes an Act. (2) A change of the designation of territories and of landed properties with objective construction to be made shall be implemented on the basis of a detailed development plan in effect subject to the terms and conditions and following the procedures set out in this Act. (3) (amend. – SG 19/09, in force from 10.04.2009; amend. - SG 92/09,

#	Subject	Law	Link	Content (English)
				in force from 20.11.2009; revoked – SG 82/12, in force from 6.11.2012) Art. 8 . District Governor : 1. ensure that the national policy to encourage the production and consumption of electricity, heat and cooling from renewable energy production and gas consumption from renewable sources , and the production and consumption of biofuels and renewable energy in transport complex the region; 2 . coordinate activities to promote the production and consumption of electricity, heat and cooling from renewable energy production and gas consumption from renewable sources, and the production and consumption of biofuels and renewable energy in transport within their region ; 4 . propose amendments adopted by municipal councils regulations and general administrative acts as authorization, certification and licensing procedures , including planning , do not meet the requirements of Art. 11.
50	Smoking policy	Health Law(art.56) Ordinance no 2 of March 22, 2004 for the min H&S requirements for carrying out construction and mounting works (Art 67)	http://www.lex.bg/bg/laws/ldoc/2135489147 http://www.lex.bg/bg/laws/ldoc/2135484003	Art. 56. (Amended - SG. 40 of 2012, in force from 01.06.2012) (1) prohibited smoking in indoor public places. (2) Smoking in premises where the work is carried ot, is prohibited . Art. 67a. (new – SG 102/06) Smoking shall be permitted only in places, designated in the order of Art. 66, par. 1, item 2, item “b”, indicated with relevant signs or boards and provided with non-flammable containers with water or sand. (Art. 66. (amend. – SG 102/06) (1) For setting up an organization of FS on the territory of the construction site the constructor shall: b) determine the places allowed for smoking.)

#	Subject	Law	Link	Content (English)
51	Smoking policy	Health Law(art.56) Ordinance no 2 of March 22, 2004 for the min H&S requirements for carrying out construction and mounting works (Art 67)	http://www.lex.bg/bg/laws/ldoc/2135489147 http://www.lex.bg/bg/laws/ldoc/2135484003	Art. 56. (Amended - SG. 40 of 2012, in force from 01.06.2012) (1) prohibited smoking in indoor public places. (2) prohibited smoking in premises with separate jobs where the work is done and on the premises them with ancillary Art. 67a. (new – SG 102/06) Smoking shall be permitted only in places, designated in the order of Art. 66, par. 1, item 2, item "b", indicated with relevant signs or boards and provided with non-flammable containers with water or sand. (Art. 66. (amend. – SG 102/06) (1) For setting up an organization of FS on the territory of the construction site the constructor shall: b) determine the places allowed for smoking.)

#	Subject	Law	Link	Content (English)
52	Soil and groundwater protection	Law of preservation of environment (Chapter 3 - Section III. Preservation, sustainable use and rehabilitation of the soils (Title amend. – SG 89/07) Article 39-44)	http://lex.bg/laws/ldoc/2135458102	Art. 39. (Amended - SG . 77 of 2005) (1) Conservation , sustainable use and restoration of soil guarantee effective protection of human health and soil functions , taking into account that the soil is limited, irreplaceable and practically irrecoverable natural resource. (2) the conservation, sustainable use and restoration of soil are to: 1. (Amended - SG . 89 2007) prevent its deterioration ; 2. the continuing multifunctional ability; 3. ensure the effective protection of human health ; 4. preservation of its qualities as a medium for normal development of soil organisms, plants and animals; 5. implementation of preventive controls to prevent adverse changes in soil and applying best practices for land use; 6. (Amended - SG . 89 of 2007) to remove and / or reduce damaging changes in the quality, caused by processes damaging soils, according to the requirements of the land use types. Art. 40. (amend. SG 77/05) The corporate bodies and the individuals, owners and/or users of landed properties shall be obliged to not cause harmful changes on the soil in their and in the neighboring landed properties. Art. 41. The owners and the users of landed properties shall be obliged to undertake measures for prevention of harmful changes, threatening the soil. Art. 42. (1) (amend. SG 77/05; amend. – SG 52/08) Who causes harmful changes of the soil shall be obliged to restore for his account its status preceding the damaging. (2) The owners and the users of underground and over-ground networks and facilities of the technical infrastructure shall be obliged to maintain them in technical fitness and to not admit pollution or other harmful change of the soil around them. Art. 44. The owners and the operators of deposits of waste, including tailings, solid waste deposits as well as facilities for preservation of waste and/or dangerous chemical substances shall organize and exploit them in a way, excluding pollution and damaging of the soil and the other components of environment. Art. 44a. (new – SG 77/05) The inventory and the investigations of areas with polluted soil, the necessary restoration measures as well

#	Subject	Law	Link	Content (English)
				as the maintenance of the realized restoration measures shall be implemented according to ordinance approved by the Council of Ministers. Art. 44b. (new – SG 77/05) The preservation, the sustainable use and the restoration of the functions of the soil shall be implemented under the conditions and by the order of this law and a special law.

#	Subject	Law	Link	Content (English)
53	Soil protection regulations in case of spills etc.	law of preservation of environment (SG 66/2013) (Article 42. Clause 1.)	http://www.moew.government.bg/files/file/Industry/Legislation/Zakoni/ZOOS.pdf	Any person who shall cause any harmful soil modification, shall be obliged to restore, at their own expense, to the condition before the soil was damaged. Art. 110a. (New - SG. 77 of 2005) (1) (suppl. - SG. 32 of 2012, effective 1.01.2013) The Minister of Environment and Water or an authorized person within 14 days of receipt of documents under Art. 110 notify the operator of any shortcomings and gaps in them and set a deadline of one month for the removal of contaminated soil. 2) (amend. - SG. 95 of 2005, No. 82 of 2006, No. 102 of 2006, SG. 93 of 2009, effective 25.12.2009 SG. 32 of 2012, effective 1.01.2013) Within three days after the deadline under para. 1 verification of documents or for the elimination of the inconsistencies and incompleteness Minister Environment and Water or an authorized officer shall send the documents under Art. 110 opinion to the Minister of Internal Affairs, the Executive Director of the Executive Agency "General Labor Inspectorate ", the mayor or appointed by those officials and to the Director of RIEWs in whose territory the undertaking and / or facility.

#	Subject	Law	Link	Content (English)
54	Storage of chemicals (hydraulic oil, epoxy paint etc. for WTGs)	Ordinance on the terms and procedure for storage of hazardous chemical substances and mixtures (Article 6) Act on Protection against Harmful Impact of Chemical Substances and mixtures (Art. 4, 25)	http://lex.bg/bg/laws/ldoc/2135734322	Art. 1. The ordinance defines: 1. obligations of individuals and legal entities that store dangerous substances and mixtures; 2. general requirements for warehouses and organization of joint storage of hazardous chemical substances and mixtures; 3 . procedure and method to evaluate the safety of storage of hazardous chemical substances and mixtures. Art.6. The construction and operation of warehouses for storage of hazardous chemical substances and mixtures persons under Art. 4 provide the following general requirements: 1. provision of transport infrastructure that satisfies the types and quantities of hazardous substances and mixtures and equipment used for loading and unloading ; 2 . separation of storage of hazardous chemical substances and mixtures of domestic and industrial premises and warehouses for food, medicines , veterinary and cosmetic products ; 3 . ensure adequate ventilation and lighting tailored to the type and quantity of hazardous substances and mixtures which are stored; Art. 4b. (New - SG. 95 of 2006, effective 24.11.2006, amended. - SG. 63 of 2010, effective 13.08.2010) (1) The procedure storage of hazardous chemical substances and mixtures shall be determined by ordinance of the Council of Ministers. (2) The procedure for limiting the manufacture, use or placing on the market of certain dangerous substances, mixtures and articles of Annex XVII to Regulation (EC) № 1907/2006 (REACH) shall be determined by ordinance of the Council of Ministers. Art. 25. (Amended - SG. 114 of 2003, effective 31.01.2004, amended. - SG. 63 of 2010, in force from 13.08.2010) In the implementation of the control subject requirements for: 16. storage of hazardous chemical substances and mixtures according to the ordinance of art. 4b, para. 1 and the conditions referred to in the safety data sheet of the manufacturer, importer or downstream user.

#	Subject	Law	Link	Content (English)
55	Tools inspections /maintenance (Calibrated Tools, High Torque Devices, MetMast inspections etc.)	Law for healthy and safe labor conditions (Art. 34) Law for Measurement (Art. 6, 7, 38, 42)	http://lex.bg/laws/ldoc/2134178305 http://lex.bg/laws/ldoc/2135449088	Art. 14. (1) The machine is designed and constructed to meet the purpose and be able to function , to be adjusted and maintained without putting persons at risk when these operations are carried out under the conditions foreseen. Any reasonably foreseeable misuse must be taken into account by the manufacturer. (2) The objective should be to eliminate any risk of accident throughout the foreseeable lifetime of the machinery, including the phases of transport, assembly, dismantling, decommissioning and scrapping. (...) Art. 18. The machine is supplied with all the special equipment and supplies that are needed to be adjusted, maintained and used safely. (...) Art. 34. (1) (Amended - SG. 40 2007) operated in accordance with their training and the instructions given to them are required: 1. make correct use of machinery, apparatus, tools, dangerous substances and materials, vehicles and other work equipment; 2. (suppl. - SG. 40 2007) given the correct use of personal protective equipment and special clothing after use to return it to its place of storage; 3. (Amended - SG. 40 of 2007) to use properly and as intended and not removed interrupted arbitrarily exclude or to modify the collective protection and safety devices fitted to machines, equipment, tools, now or building; 4. immediately inform the employer or the relevant officials in each situation arose at work, which could present an immediate danger to health for all faults in the means of collective protection; 5. (amended and supplemented. - SG. 40 of 2007) to assist the employer to the relevant officials and / or representatives of employees on safety and health at work in the implementation of the arrangements for ensuring health and safety work and the requirements given by the control authorities. (2) (Amended - SG. 40 2007) Every worker who temporarily removes remedy or signaling in the repair , installation, and other prevention is obliged to repair it immediately or take other protective measures with the same efficiency. Rules and responsibilities for calibration and checks of the measuring devices and tools are set in the law

#	Subject	Law	Link	Content (English)
				Art. 6. (1) Metrological control include: 1. control of measuring instruments; 2. metrological examinations of measuring instruments; 3. control of pre- packed products and packaging designed to be used as containers for measurement. (2) The control of metering is performed for compliance with the requirements of Chapter Four and the ordinance under Art. 28. (3) The metrological expertise of measurement is carried out in the event of a dispute regarding the technical and metrological characteristics of measuring instruments in use at the request of individuals or legal entities. (4) The pre- packaged products and packaging designed to be used as containers for measurement shall be made for compliance with the requirements for their quantities or capacities. Art. 7. Subject to the provisions of this Act and the regulations for its implementation is carried out metrological supervision. Art. 38. (Amended - SG. 95 2005, in force from 01.03.2006) Initial and subsequent verification of measuring equipment shall be performed by the Bulgarian Metrology Institute or persons authorized by the State Agency for Metrology and technical supervision. Art. 42. (1) The initial verification of measuring instruments imported from the country - State of the Union, marked by a competent authority with the mark of conformity to the approved type and / or with the requirements of European Union Directive for the measuring devices is done by checking a sample of the batch of these measuring devices. (2) The results of the initial verification of measuring instruments are recognized if the check is carried out by a competent authority of another country with which the Republic of Bulgaria has signed an agreement of mutual recognition.
56	Use of plant and equipment	Ordinance № 7 of September 23, 1999 for the minimal requiremen ts for healthy and	/www.lex.bg/bg/laws/ldoc/-549670400	Art. 28. Operators and workers who have been entrusted with the management or use of construction equipment , tools or construction guns : 1. comply with the operating instructions , instructions for safety and health requirements of the ordinance for the machine or instrument; 2 . Before starting work check the functioning of machines and tools , and runtime monitor their condition , while failure terminated work ; 3 . in collaboration with the signalman just carry any signals ;

#	Subject	Law	Link	Content (English)
		safe conditions of work at the working places and in using the working equipment (Art. 3, 4, 5) Ordinance no 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementing construction and mounting works (Article 19, 28) Ordinance of the essential requirements and conformity assessment of machinery	http://lex.bg/laws/ldoc/2135592478	4 . execute the orders of the foreman , and in his absence - of his deputy or foreman in charge of the implementation of the relevant type of works, except where such orders conflict with the requirements for safe operation of the machine. Art. 19. (1) Instructions on safety and health include: 1. rights, obligations and responsibilities of those who manage or control the relevant working processes; 2 . required competency or qualifications of workers to perform works on specific building technologies and operators of construction equipment and tools; 3 . OHS requirements : a) Before , during and upon termination , termination and completion of the work; b) how to use the construction machines and other work equipment; c) testing and sampling functionality of the equipment and installations; Art. 2 . The employer shall ensure that the requirements of this Ordinance for the jobs, the labor process and the use of work equipment provided . Art. 3 . (Amended - SG . 88 2004 , in force from 05.11.2004) In addition to the obligations under the HSWA employer : 1. (suppl. - SG . 43 2003 , suppl. - SG . 40 2008) inform the workers and / or their representatives on health and safety at work of all measures related to safety and protection health , which are to be undertaken in the workplace and the use of work equipment. The information should be easily understood by workers concerned 2 . (suppl. - SG. 40 of 2008) in consultation with workers and / or their representatives on health and safety at work and an opportunity for their participation in all matters related to this ordinance. Art. 4 . In the organization and implementation of work to meet the requirements of this Ordinance, the relevant regulations on safety and health at work for various industries, activities, types of work and work equipment and fire safety.

#	Subject	Law	Link	Content (English)
57	Ventilation, Light requirements in WTGs, Offshore Foundations and WTG maintenance warehouses	Ordinance № 7 of September 23, 1999 for the minimal requirements for healthy and safe conditions of work at the working places and in using the working equipment (Chapter 4; Section IV) (Art. 124-130)	http://pravo5.ciela.net/Document.aspx?id=- http://www.lex.bg/bg/laws/ldoc/-549670400	Section IV. Ventilation of the working places in the premises Art. 124. (amend. SG 88/04) The production and auxiliary premises shall be aired by natural or mechanical ventilation, providing the necessary air exchange in compliance with the nature and the intensity of work, the physiological needs of the workers and the established norms of air velocity, temperature and relative humidity. Art. 125. (1) Compulsory ventilation shall be provided in working premises where dust, toxic and other harmful substances are released. Local ventilation shall be provided at the source of release of harmful substances. Art. 126. (1) Using a system of compulsory ventilation shall be provided with effective and reliable functioning and maintenance. For the protection of the health of the workers, it is necessary that each accidental interruption of the ventilation to be signaled by a control system. Art. 127. (1) In using climatic or ventilation installation it shall not be admitted for the workers to be subjected to harmful air drafts. (2) Deposits and pollution which create immediate danger for the health of the workers shall immediately be removed. Art. 128. In the cases when there is a possibility of emergency release of strong toxic substances or creation of explosive and highly inflammable concentrations in the working premises or places emergency ventilation system shall automatically be operated. Art. 129. In technological processes related to the using, obtaining or storing toxic substances or probability of creating explosive mixtures depending on the existing risk one or more technical decisions shall apply: 1. automatic switching of the ventilation systems at the beginning of the technological process; 2. automatically operated ventilation, signaling, emergency, fire alarm or fire extinguishing systems; 3. stopping of the production process and signaling; 4. neutralization of the harmful substances.

#	Subject	Law	Link	Content (English)
				Art. 130. The local suction installations servicing equipment which release strong toxic gases and dust and the common exchange ventilation installations in working premises of the category of production A and B shall be installed in such a way as to be started simultaneously with the technological equipment and prevent its start in cases of failure of the ventilation.
58	Waste disposal	Ordinance no 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementing construction and mounting works S (Article 16, para.1(m); Article 36)		Art. 16. The constructor shall: 1. ensure:(m) the collecting, the preservation and the transportation of wastes and debris; Art. 36. (1) The construction wastes shall be preserved in appropriate way at an especially equipped plot. The constructor shall determine in writing its location for each construction, the concrete activity for waste management and the persons, responsible for their fulfilment. (2) Throwing out of construction wastes or elements of working equipment shall not be admitted through the openings of the floors. For this purpose shall be used cranes, lifts, closed chutes or other appropriate devices and respective packing. (3) When the construction wastes are thrown out from the construction by chutes (waste conduits), they shall be made and mounted so that not to dust or pollute the working ambience or the environment.
59	Water/Wastewater regulation	Law for the Waters (Art. 2) Ordinance № 6 of	http://www.lex.bg/bg/laws/ldoc/21346734	Art. 2 . (Amended - SG . 65 2006 , in force from 11.08.2006) (1) The purpose of the law is to ensure integrated water management in the public interest and for the protection of public health and to create conditions for : 1. (Amended - SG . 47 of 2009 , effective 23.06.2009) The provision of sufficient quantity and quality of surface and groundwater for

#	Subject	Law	Link	Content (English)
		November 9, 2000 for emission standards for the admissible contents of harmful and dangerous in waste waters, discharged in water sites (Art.1, 2)	12 http://pravo5.ciela.net/Document.aspx?id=-549403646&category=normi&lang=en-GB&interpretedQuery=%D0%B5%D0%BC%D0%B8%D1%81%D0%B8%D0%BE%D0%BD%D0%BD%D0%B8+%D0%BD%D0%BE%D1%80%D0%BC%D0%B8 http://www.lex.bg/bg	sustainable , balanced and equitable water use ; 2 . reducing water pollution ; 3 . protection of surface and groundwater and the Black Sea; 4 . pollution of the marine environment by natural or synthetic substances; 5 . reduction of discharges, emissions and losses of priority substances ; 6 . cessation of discharges, emissions and losses of priority hazardous substances; 7 . (new - SG . 61 of 2010) to prevent or reduce harmful effects on human life and health, the environment , cultural heritage and economic activity associated with the harmful effects of water . (2) The objectives of para . 1 is achieved by: 1. prevent deterioration and protect and improve the status of aquatic ecosystems directly dependent terrestrial ecosystems and wetlands ; 2 . promote sustainable use of water through long-term protection of available water resources; 3 . complex , multiple and efficient use of water resources; 4 . implementation of measures to protect and improve the aquatic environment; 5 . ensuring the continuous reduction of pollution of groundwater and prevent contamination ; 6 . reduce the effects of floods and droughts ; 7 . (new - SG . 61 2010) The assessment and management of flood risks. Art. 1. (1) This regulation sets emission standards for permissible levels of certain dangerous substances in waste water discharged into water bodies. (2) Since the scope of the regulation excludes all discharges of wastewater into groundwater. Art. 2. (1) The purpose of the ordinance is to prevent and / or suspend and reduce water pollution of water bodies by Hazardous and Noxious Substances covered her

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			/laws/ldoc/2134906371	
60	Wild life protection	Law of preservation of environment (Article 51) Also see: Law for the biological diversity (Art.6)	http://lex.bg/laws/ldoc/2135458102 http://lex.bg/laws/ldoc/2135456926	Art. 51. (1) The species, the habitats of the species and the natural habitats with their intrinsic biological diversity shall be subject to preservation and protection. (2) The preservation of diversity of natural habitats and species of wild flora and fauna shall be implemented under the conditions and by the order of a special law. (3) (new – SG 77/05) The preservation and the use of natural landscape shall be implemented in a way and with means not admitting harmful impact, irrecoverable changes and/or damaging of its elements. ****** Art. 6. (1) Protected areas are designated for: 1. (suppl. - SG. 94 2007) conservation of habitat types under Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora listed in Annex № 1 ; 2 . (Amended - SG. 94 2007) Protection of habitats under Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora - species of animals and plants listed in Annex №2; 3. (Amended - SG. 94 2007) protection of habitats in Council Directive 79/409/EEC on the conservation of wild birds - a bird species listed in Annex № 2; 4. Conservation areas in which during reproduction, wintering or migration gather significant amounts of bird species than those listed in Annex № 2. (2) (suppl. - SG. 94 2007) endangered habitat types listed in Annex № 1 and marked with an asterisk (*) are priorities for conservation. (3) (suppl. - SG. 94 2007) endangered plant and animal species listed in Annex № 2 and marked with an asterisk (*) are priority.

#	Subject	Law	Link	Content (English)
61	Wind turbines -- Part 25-5: Communications for monitoring and control of wind power plants - Conformance testing	БДС EN 61400-25-5:2007	http://www.bds-bg.org/bg/standard/?natstandard_document_id=45329	Specifies standard techniques for testing of conformance of implementations, as well as specific measurement techniques to be applied when declaring performance parameters. The use of these techniques will enhance the ability of users to purchase systems that integrate easily, operate correctly, and support the applications as intended.
62	Work permits	Ordinance for the conditions and the order of issuing, refusal and revoking work permits of foreigners in the Republic of Bulgaria (Art.1, 2, 9, 10)	http://www.lex.bg/bg/laws/ldoc/-548909054	Art. 1. (1) (prev. text of art. 1 - SG . 56 2007) The ordinance governing 1. terms and conditions for the issuance, renewal, denial and revocation of work permits for foreigners in the Republic of Bulgaria ; 2 . exemptions from the issuance of work permits for foreigners in the Republic of Bulgaria ; 3 . permissible total length of employment; 4 . (new - SG . 50 of 2011 , in force from 15.06.2011) the conditions and procedure for the granting , refusal and withdrawal of the warrant for the exercise of highly qualified employment under Art. 74b of the Law on Employment Promotion in conjunction with a single permit for work and residence type “EU Blue Card " . (2) (New - SG . 56 2007) This regulation applies to persons who are not nationals of a Member - State of the Union or of a State - party to the Agreement on the European Economic Area or the Swiss Confederation which, by virtue of an international treaty with the European Union have the right to free movement. Art. 2. (1) The work permit is a personal document that certifies the alien to perform work in the territory of the Republic of Bulgaria only for specific legal or natural person and referred to in a location, position , type and duration. (2) A work permit is issued to a person : 1. Hiring an employment relationship by the employer within the meaning of the Labor Code; 2 . (Amended - SG. 53 2003, suppl. - SG . 56 2007) seconded to the provision of services in the Republic of Bulgaria , with the exception

#	Subject	Law	Link	Content (English)
				of the cases of art . 4, para. 3 and 4. (3) (suppl. - SG . 56 2007) The work permit is issued by the Executive Director of the Employment Agency in accordance with the Annex . Art. 9. (1) (suppl. - SG. 56 2007) A work permit is issued for the period for which the alien is offered an employment contract or seconded, but no more than one year. (2) If the alien is residing as a family member pursuant to Art. 24, para. 1, item 13 of the Foreign Nationals Act, the work permit is issued for the period of authorized stay. Art. 10. (1) (Amended - SG. 92 2004, suppl. - SG. 56 2007 , suppl. - SG . 50 of 2011 , in force from 15.06.2011 g .) issued a work permit may be extended for up to 12 months if the grounds for the initial issuance of the permit and no break in employment. Of an employee work permit may be extended in exceptional cases up to 12 months if, due to force majeure, the activity for which it is sent , requires exceeding the originally announced duration. (2) (Amended - SG . 56 of 2007) For employees under labor contract in Bulgaria the total duration of the work permit and its extensions may not exceed three years . (3) can be extended over the 3- year period of employment permits to work on: 1. senior management of companies and branches of foreign companies established in the Republic of Bulgaria ; (4) (New - SG . 92 of 2004, amended . - SG. 56 of 2007, amended. - SG. 50 of 2011 with effect from 15.06.2011 amend. - SG. 60 of 2011, in force from 15.06.2011) in case of early termination of employment or after reaching the maximum period allowed under par. 2 documents for a new work permit, the foreigner must be submitted at least one month break in employment and residence on the territory of the Republic of Bulgaria in the past and want a new start date of employment and in accordance with the requirements of Art. 3 except under Art. 6, para. 2, item 8.

#	Subject	Law	Link	Content (English)
63	Work Restrictions door to high temp.& low tempr.	Ordinance on № 7 of 23 September 1999 on the minimum health and safety of workers at workplaces and the use of work equipment. (Art.82) Ordinance no 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementing construction and mounting works (Article 16)	http://www.lex.bg/bg/laws/ldoc/-549670400 http://www.lex.bg/bg/laws/ldoc/2135484002	Art. 82. (Amended - SG. 40 2008) During working hours, the temperature of workplaces of the people who constantly work shall meet the established standards and comply with the working methods used and physiological requirements. Art. 16. The contractor shall ensure to undertake additional measures for protection of the workers at open air working places upon unfavorable climatic conditions;

#	Subject	Law	Link	Content (English)
64	Working at height regulations	Ordinance no 2 of March 22, 2004 for the minimum requirements for healthy and safe labor conditions at implementing construction and mounting works (Article 9; Article 10; Article 40;Article 60-64; Article 87 also the whole of chapter 3 which describes the use of ladders; scaffolds)	http://www.lex.bg/bg/laws/ldoc/2135484002	Art. 9. (1) The assignor or the person, authorized by him shall assign to the designer or to the coordinator of safety and health for the stage of the investment designing the working out of the plan for safety and health and present it to the constructor before the opening of the construction site. (...) Art. 60. (1) Works at height shall be implemented upon ensured safety from falling of people or subjects by appropriate equipment, collective and/or personal protection aids (e. g. fencing, scaffolds, platforms and/or protective (safeguarding) nets). (2) When due to the character of the work the using of the equipment and the means of para 1 is impossible, appropriate opportunities for access shall be provided with using of anchored facilities or protection belts, catches to stable and strong construction. Art. 61. The falls from height shall be prevented by facilities (equipment, fencing), which are sufficiently high and constructed by at least protective board strip for feet, main parapet for hands and intermediate parapet for hands or by alternative solution. Art. 62. (1) For prevention of risk from falling at work at height shall be ensured means for collective protection from falling of people, instruments, products etc. (...) (4) The people, working at height shall put their instruments in a special bag or case, safeguarded from falling. Art. 63. (1) The lifting and descending to and from height of any kind of loads (construction products, shutter elements, instruments etc.) shall be done primarily in mechanized way. Art. 64. The working platforms, the passing bridges and the stairs within the boundaries of the construction site shall be dimensioned so that to have sufficient strength and shall be safeguarded and used so that to protect the people from falling subjects. Art. 87. (1) For implementing construction works at height scaffolds, platforms and cradles, which have instruction by the producer for mounting, exploitation, admissible loads, dismantling and safe work requirements, shall be used.

#	Subject	Law	Link	Content (English)
				(2) Scaffolds, platforms and cradles, which do not meet the requirements of para.1 as well as their combination for different type and kind usage may be permitted only after calculation and dimensioning according to individual design, which is to be in compliance with their designation.

#	Subject	Law	Link	Content (English)
65	Working time restrictions	Labor Act (Chapter seven. Working hours and rest) (Art.136-155) Ordinance for the working time, breaks and holidays (Art.4, 5)	http://lex.bg/laws/ldoc/1594373121 http://lex.bg/laws/ldoc/-552858623	This chapter regulates: the working hours; overtime fours; rest Defines the rights and obligations of the employees. Normal working hours Art. 136. (Amended - SG . 100 of 1992) (1) (Amended - SG . 25 of 2001 , effective 31.03.2001) The work week is five days with normal weekly working time to 40 hours. (2) (Repealed - SG. 25 of 2001, in force from 31.03.2001) (3) (Amended - SG . 25 of 2001 , effective 31.03.2001) The normal hours of work per day is 8 hours. (4) (suppl. - SG. 25 of 2001, effective 31.03.2001) The normal hours of work in the preceding paragraphs cannot be extended , except in cases and under the procedure laid down in this code. (5) (Revoked - SG. 25 of 2001, in force from 31.03.2001) Extension of working hours Art. 136a. (New - SG . 25 of 2001 , effective 31.03.2001) (1) (Amended - SG . 48 of 2006 , in force from 01.07.2006) In production reasons an employer may by written order extend opening hours in some days and it compensates by shorter in others, after prior consultation with representatives of trade unions and representatives of employees under Art. 7, para. 2. Extension of working time, the employer is required to notify in advance the labor inspectorate. (2) (suppl. - SG . 52 of 2004 , effective 01.08.2004) The duration of the extended time under the conditions of para . 1 cannot exceed 10 hours for employees with reduced working hours - up to 1 hour over their reduced working hours. In these cases the length of the working week cannot exceed 48 hours for employees with reduced working hours - 40 hours. The employer must keep a special book reading extension appropriate compensation for working time. (3) The extension of working time under par. 1 and 2 are allowed for a period of 60 working days in one calendar year but not more than 20 days consecutively. (4) In the cases under par. One employer is required to compensate for the extension of working hours by shorter within four months of each extended working day . Where the employer does not compensate for the extension of working hours in that period , the employee has the right to define the time that will be offset extension of working hours by shorter by notifying the employer in writing at least two weeks in advance . (5) Upon termination of employment prior to compensation under

#	Subject	Law	Link	Content (English)
				par. 4 difference to the normal working day shall be paid as overtime. (6) For employees under Art. 147 extension of time shall be allowed under this article for overtime work. Reduced working hours Art. 137. (1) (prev. text of art. 137 - SG . 25 of 2001 , effective 31.03.2001) Reduced working hours established for: 1. (Amended - SG . 100 of 1992, as amended . - SG . 83 2005) employees who work under specific conditions and risks to life and health cannot be removed or reduced , despite the measures taken , but the reduction of working hours leads to limiting the risks to their health ; 2 . (Amended - SG. 100 of 1992) employees aged under 18. (2) (New - SG . 83 2005) The types of work that establishes reduced working hours shall be determined by ordinance of the Council of Ministers. (3) (New - SG . 25 of 2001 , effective 31.03.2001 , prev. 2 - SG . 83 2005) Right of reduced working time under par. 1, item 1 have employees who work in the relevant conditions not less than half the statutory working time. (4) (New - SG . 25 of 2001 , effective 31.03.2001 , prep . 3 - SG . 83 of 2005) in the reduction of working time under par. 1 and 2 are not reduced wages and other rights of the employee in the employment relationship. Distribution of working time Art. 139 . (1) The distribution of working time is established by the regulations for the internal work order now . (2) (Amended - SG . 100 1992) in enterprises in which the organization of work permits, may establish time varying boundaries . The time during which the employee must be at work in the enterprise, and the way of reporting shall be determined by the employer. Out of Time compulsory attendance employee sets himself the beginning of their working time . (3) Depending on the nature of work and work organization of the working day can be divided into two or three parts. (4) (Amended - SG . 100 of 1992, as amended . - SG . 25 of 2001 , effective 31.03.2001 , repealed . - SG . 48 2006 . , in force from 01.07.2006) (5) (Amended - SG . 100 of 1992, as amended . - SG . 25 of 2001 , in force from 31.03.2001) For certain categories of employees because of the special nature of the work they can be the establishment on

#	Subject	Law	Link	Content (English)
				duty or obligation to be available to the employer for a certain time of the day. Categories of employees , the maximum length of time and procedure for reporting shall be determined by the Minister of Labor and Social Policy. Irregular working hours Art. 139a . (New - SG . 48 of 2006 , in force from 01.07.2006) (1) Due to the special nature of the work the employer in consultation with representatives of trade unions and representatives of employees under Art. 7, para . 2 can be established for certain posts irregular working hours . (2) (New - SG . 108 of 2008) can not be set irregular working hours for employees with reduced working hours. (3) (prev. . 2 - SG . 108 of 2008) list of posts which are set irregular working hours shall be determined by order of the employer. (4) (prev. . 3 - SG . 108 of 2008) Employees with irregular working hours are required when necessary to perform their job and after the regular working hours. (5) (prev. . 4 - SG . 108 of 2008) In the cases under par. 3 employees are entitled to breaks apart under Art. 151 and rest at least 15 minutes after the regular working hours. (6) (prev. . 5 - SG . 108 of 2008) In the cases under par. 3 total hours of work may not violate the continuous minimum daily and weekly rest periods established by this Code. (7) (prev. . 6 - SG . 108 of 2008) work over regular working hours on working days is offset by additional paid annual leave and work weekends and holidays - with increased remuneration for overtime. Night work Art. 140 . (1) (Amended - SG . 25 of 2001 , effective 31.03.2001) The normal weekly working time at night at 5 -day working week is 35 hours . Normal working hours at night at 5 -day working week to 7 hours. (2) (Amended - SG . 25 of 2001 , effective 31.03.2001) Night work is to be applied from 22.00 am to 06.00 pm and juvenile workers employees - from 20.00 am to 06.00 pm (3) (Amended - SG . 100 of 1992) The employer shall provide employees hot food , refreshments and other facilitating conditions for the effective application of night work. (4) (Amended - SG . 100 of 1992) Night work is prohibited for: 1. employees who have not reached the age of 18 ; 2 . (Amended - SG . 52 of 2004 , effective 01.08.2004 , suppl. - SG .

#	Subject	Law	Link	Content (English)
				103 of 2009 , effective 29.12.2009) Pregnant workers as and workers and employees in an advanced stage of IVF treatment ; 3 . (Amended - SG . 52 of 2004 , effective 01.08.2004) mothers with children under 6 years of age and mothers who care for children with disabilities, regardless of age, except in their written consent; 4 . reassigned employees except with their consent and if that does not adversely affect their health in the opinion of the medical authorities ; 5 . employees who continue their education without interruption of production except with their consent. (5) (new - SG . 52 of 2004 , effective 01.08.2004 , repealed . - SG . 48 of 2006, in force from 01.07.2006) Special rules for night work Art. 140a . (New - SG . 48 of 2006 , in force from 01.07.2006) (1) Employees in regular working hours which shall include at least three hours of night work of art. 140 , para . 2 , as well as employees who work in shifts , one of which includes at least three hours of night work shall be considered as employees who perform night work. (2) Employees who work at night shall be employed only after preliminary medical examination, which is paid by the employer. (3) Employees who work at night are subject to periodic examinations of art. 287 . (4) When the health authority finds that the health condition of the employee has deteriorated due to night work , he moved to suitable day work or reassigned . (5) The employer in which employees work at night shall, upon request of the Executive Agency "General Labor Inspectorate" to supply information about their number, worked night hours , and measures taken to ensure a safe and healthy working conditions. Shiftwork Art. 141 . (1) Where the nature of the production process imposed work now organize two or more shifts. (2) The work shift is mixed when it includes day and night . Mixed shift with 4 or more hours of night work be considered for night and lasts the night shift , and less than 4 hours of night work is considered to be living there and duration of the day. (3) rotation of shifts in the enterprise is determined by the regulations for the internal work order . (4) (Amended - SG . 100 1992) work shifts of employees to continue their education without interruption of production, as well as

#	Subject	Law	Link	Content (English)
				students who work in their free time are determined depending on the organization of the educational process . (5) It is prohibited to assign work two consecutive shifts. (6) (Amended - SG . 100 1992) in production with continuous work process the employee cannot suspend their work until the arrival of the shift worker it without the permission of the immediate supervisor. In these cases, the immediate superior shall be obliged to take the necessary steps to find a substitute employee . Art. 143 . (1) (Amended - SG . 100 of 1992, as amended . - SG . 25 of 2001 , effective 31.03.2001) Overtime is work that is applied in order or with knowledge and without opposition from the employer or the relevant head of the employee outside his normal working hours. (2) Overtime is prohibited . Art. 144 . Overtime is allowed as an exception only in the following cases: 1. to perform work in connection with the defense of the country ; 2 . (Amended - SG . 100 of 1992, as amended . - SG . 19 2005 , suppl. - SG . 102 of 2006, as amended . - SG . 35 2009 , in force from 12.05.2009) for the prevention, control and overcome the effects of disasters; 3 . (Amended - SG . 100 1992) for carrying out urgent public need work to restore water , electricity , heating , sanitation , transport and communication links and medical assistance ; 4 . (Amended - SG . 100 1992) for carrying out emergency repairs and restoration work in the workplaces , machinery or other equipment; 5 . (Amended - SG . 100 of 1992, as amended . - SG . 108 of 2008) to complete the work started , which can not be performed during regular working hours ; 6 . (new - SG . 100 of 1992) to perform intensive seasonal work. Breaks in the working day Art. 151 . (1) (Amended - SG . 100 of 1992) The hours an employee is interrupted by one or more breaks. The employer provides the employee meal breaks , which may not be less than 30 minutes. (2) The holidays are not included in working time. (3) (Amended - SG . 100 of 1992, as amended . - SG . 25 of 2001 , in force from 31.03.2001) In enterprises with a continuous process of working in enterprises which runs continuously , the employer provides the employee feeding time during working hours. daily rest Art. 152 . (Amended - SG . 100 of 1992) , an employee is entitled to a

#	Subject	Law	Link	Content (English)
				continuous daily rest period , which may not be less than 12 hours. weekly rest Art. 153 . (1) (Amended - SG . 100 of 1992), a five-day workweek the employee is entitled to a weekly rest period at the rate of two days , one of which is to begin on Sunday. In these cases, the employee shall be provided at least 48 hours of continuous weekly rest . (2) (Amended - SG . 25 of 2001 , effective 31.03.2001 , amended . - SG . 52 of 2004 , in force from 01.08.2004) When summed calculation of working hours uninterrupted weekly rest period is not less than 36 hours . (3) (New - SG . 52 of 2004 , in force from 01.08.2004) In case of change in summarized calculation of working hours uninterrupted weekly rest period may be smaller than a paragraph break . 2, but not less than 24 hours , where the actual technical and organization of work in the enterprise requires. (4) (New - SG . 52 of 2004 , in force from 01.08.2004) In overtime both days of the weekly holiday with a daily calculation of working time, the employee shall be entitled in addition to increased wage this work and continuous rest next week in an amount not less than 24 hours. holidays Art. 154 . (Amended and supplemented . - SG . 30 of 1990 , amended . - SG . 27 of 1991, amended . - SG . 104 of 1991, as amended . - SG . 88 of 1992 , amended . - SG . 2 of 1996) (1) (suppl. - SG . 22 of 1998, amended . amended and supplemented . - SG . 56 1998 . , suppl. - SG . 108 of 1998, amended . - SG . 15 2010) Official holidays are: January 1 - New Year March 3 - Day of the Liberation of Bulgaria from Ottoman rule - the National Day ; May 1 - Labor Day and International Workers' Solidarity May 6 - St. George's Day , Day of the Bulgarian Army ; May 24 - Day of Bulgarian Education and Culture , and Slavonic Literature ; September 6 - Day of Unification ; September 22 - Independence Day of Bulgaria ; November 1st - Day of National Leaders - holiday for all educational institutions; December 24 - Christmas Eve , 25 and 26 December - Christmas ; Good Friday , Holy Saturday and Easter - Sunday and Monday in the year are set to celebrate it.

#	Subject	Law	Link	Content (English)
				(2) (suppl. - SG . 52 of 2004 , effective 01.08.2004 , amended . - SG . 15 2010) The Council of Ministers may announce other days off for national official holidays, and days of celebration of certain professions days to render gratitude to rearrange weekends during the year. In these cases, the duration of the week may be greater than 48 hours , but the duration of the weekly rest - less than 24 hours. Hours and holidays when dealing with specific subjects and / or labor organization Art. 154a . (New - SG . 48 of 2006 , effective 01.07.2006) Subject to the general rules for ensuring health and safety of Ministers may establish other , daily , weekly or monthly working time , daily and weekly rest breaks in the working day and night work for employees who work with specific characteristics and / or labor organization . Art. 155 . (Amended - SG . 100 of 1992) (1) (Amended - SG . 52 of 2004 , effective 01.08.2004) Every employee is entitled to paid annual leave . (2) (New - SG . 52 of 2004 , in force from 01.08.2004) Upon receipt of the first job the employee may use paid annual leave when it acquires at least eight months service . (3) (New - SG . 52 of 2004 , in force from 01.08.2004) Upon termination of employment before acquiring eight months of service the employee is entitled to paid annual leave calculated in accordance with Art. 224 , para . 1. (4) (Amended - SG . 25 of 2001 , effective 31.03.2001 , previous paragraph . 2 - SG . 52 of 2004 , in force from 01.08.2004 g .) The amount of paid annual leave is not less than 20 working days. (5) (Amended - SG . 100 of 1992, as amended . - SG . 25 of 2001 , effective 31.03.2001 , previous paragraph . 3 am. - SG No. . 52 of 2004 , effective 01.08.2004) Certain categories of workers , depending on the specific nature of the job are entitled to an extended paid leave , which included maternity al . 4 . Categories of employees and the minimum amount of such leave shall be determined by the Council of Ministers . Additional paid leave Art. 156 . (1) (Amended - SG . 100 of 1992, as amended . - SG . 52 of 2004 with effect from 01.08.2004 , the previous Article . 156 - SG . 83 of 2005) under Art . 155 , para . 2 employee is entitled to additional paid leave : 1. (Amended - SG . 83 2005) to work under specific conditions and

#	Subject	Law	Link	Content (English)
				risks to life and health , which can not be eliminated , restricted or reduced , despite the measures taken - not less than 5 days ; 2 . (Amended - SG . 25 of 2001 , effective 31.03.2001) to operate at irregular working hours - not less than 5 working days. (2) (New - SG . 83 2005) The types of work for which additional paid annual leave shall be determined by ordinance of the Council of Ministers. Art. 4a . (New - SG . 10 2009 new - SG . 67 of 2009) (1) Rules of internal labor determine the beginning and end of the day , the order of succession of shifts , breaks at work , the order of time reporting , time necessary part of the establishment, where agreed flexible working hours feeding time employees in enterprises with a continuous process of working in enterprises which operate continuously, and other issues related to the allocation of working time and work organization in the enterprise. Art. 5 . (1) (Amended - SG . 54 of 2001 , effective 31.03.2001 , repealed . Unlawful by Decision № 9353 of 21.10.2002 SAC - SG . 103 2002 on) (2) (Amended - SG . 54 of 2001 , effective 31.03.2001 , repealed . Unlawful by Decision № 9353 of 21.10.2002 SAC - SG . 103 2002 on) (3) The hours variable limits on a daily calculation of a normal duration. In time varying boundaries may be established and summarized calculation of working time under the terms and conditions of Art. 142 , para . 2 CT . (4) with variable limits of working time can not violate the minimum size for lunch , daily and weekly rest . (5) (Amended - SG . 54 of 2001 , effective 31.03.2001 , repealed . Unlawful by Decision № 9353 of 21.10.2002 SAC - SG . 103 2002 on)
66	Working under suspended loads during loading and unloading WTG componen	Ordinance № 12 of 30.12.2005 for the provision of health and safety when carrying out loading and unloading	http://www.lex.bg/bg/laws/ldoc/2135516052	Art. 3. In organizing and carrying out loading and unloading unless the provisions of this Ordinance shall perform the requirements of: 1. Ordinance № 7 of 1999 on the minimum health and safety of the workplace and the use of work equipment 2001, as amended. issue. 43 2003 pcs. 37 and 88 of 2004); 2. Ordinance № 10 of 2004 on ensuring health and safety at work with trucks and forklifts (SG. 112 of 2004); 3. Ordinance № 12 of 2004 to ensure the health and safety of work with cars (SG. 6 of 2005); 4. Ordinance № 16 of 1999 physiological norms and rules for manual

#	Subject	Law	Link	Content (English)
	ts	work (Art.3, 4, 5)		handling of loads (SG. 54 of 1999); 5. regulations of art. 31 of the Law on technical requirements for products; 6. regulations containing requirements for loading and unloading of vehicles for rail, water and air transport and road vehicles; 7. regulations for fire and rescue; 8. other regulations on safety and health at work. Art. 4. (1) The employer shall: 1. take all necessary measures to ensure healthy and safe working conditions during loading and unloading, and when they are done by hand - to prevent or reduce manual handling; 2. inform employees about all possible risks when loading and unloading, of any measures taken to eliminate, reduce and control these risks, and in all matters relating to the provision of health and safety at loading and unloading; 3. consultation with workers and/or their representatives and an opportunity for their participation in all matters relating to this Ordinance; 4. ensure the development and introduction of regime of work and rest for a specific type of handling; 5. provide workers performing loading and unloading with personal protective equipment, in accordance with the specificity of the handling and the resulting risks. (2) When loading and unloading are carried out by several companies or organizations, employers jointly written agreement providing healthy and safe working conditions, inform each other about work hazards and coordinate their activities to protect workers from these hazards. (3) Every worker in the course of loading and unloading must: 1. perform exactly the instructions given to protect the health and safety during loading and unloading and assisting the employer to implement the relevant measures; 2. the intended use technical means and equipment procured and provided by the employer; 3. increased skills and knowledge regarding the health and safety conditions at loading and unloading . Art. 5. (1) The employer shall develop and approve understandable written about working rules to ensure safe and healthy working

#	Subject	Law	Link	Content (English)
				conditions during loading and unloading. (2) The rules under par.1 shall not contravene the provisions of the regulations and take account the specificity of the handling. (3) The employer shall use the rules under par.1 in the training and instruction of employees. (4) The employer shall provide employees the rules under par.1 and/or put them in accessible places, close to places of loading and unloading.

Appendix J.

Dangerous Occurrences

LIFTING EQUIPMENT

The collapse of, the overturning of, or failure of any load-bearing part of any:

a. Lift or hoist
b. Crane or derrick
c. Mobile powered access platform
d. Access cradle or window cleaning cradle
e. Excavator
f. Pile-driving frame or rig having an overall height when operating of more than 7 metres
g. Forklift truck

PRESSURE SYSTEMS

The failure of any closed vessel (including boiler or boiler tube) or of any associated pipe-work, in which the internal pressure was above or below atmospheric pressure, where the failure has the potential to cause the death of any person. It applies to any such vessel whatever its contents that are to a vessel containing air, steam, water, or any other gas, vapor or liquid. It applies to moveable and fixed vessels.

OVERHEAD ELECTRIC LINES

Any unintentional incident in which plant or equipment either;

a. Comes into contact with an uninsulated overhead electric line in which the voltage exceeds 200volts or
b. Causes an electrical discharge from such an electric line by coming into close proximity to it.

ELECTRICAL SHORT CIRCUIT

Electrical short circuit or overload attended by fire or explosion which results in the stoppage of the plant involved for more than 24 hours or which had the potential to cause the death of any person.

COLLAPSE OF SCAFFOLDING

The complete or partial collapse of:

a. Any scaffold which is :
   i. More than 5 meters in height which results in a substantial part of the scaffold falling or overturning; or
   ii. Erected over or adjacent to water such that there would be a risk of drowning to a person falling from the scaffold into the water; or
b. The suspension arrangements (including any outrigger) of any slung or suspended scaffold which causes a working platform or cradle to fall.

COLLAPSE OF WTG, METMAST or OSP STRUCTURE

Any unintended collapse or partial collapse of:

a. Any structure (whether above or below ground) under construction, reconstruction, alteration or demolition which involves a fall of more than 5 tons of material;
b. Any floor or wall of any structure (whether above or below ground) used as a place of work; or
c. Any false-work.

EXPLOSION OR FIRE

An explosion of fire occurring in any plant or premises which results in the stoppage of that plant or as the case may be the suspension of normal work in those premises for more than 24 hours, where the explosion or fire was due to the ignition of any material.

OTHER REPORTABLE DANGEROUS OCCURRENCES

a. Incidents involving Explosives
b. Incidents involving Biological Agents
c. Malfunction of Radiation Generators
d. Incidents involving Breathing Apparatus
e. Incidents involving Pipelines or Pipeline Works
f. Incidents involving the Carriage of Dangerous Goods by Road
g. Escapes of Flammable and other Substances

Appendix K.

Reportable Diseases

There are far too many diseases, which are reportable, can be included in this appendix. However, the workers who are involved in OWFs and ONWFs are likely to be exposed to following diseases:

a. Physical Agents or Physical Demands of Work
b. Cramp of the Hand or Forearm due to repetitive work movements
c. Carpal Tunnel Syndrome
d. Hand Arm Vibration or Vibration White Finger

Infections due to Biological Agents:

a. Hepatitis
b. Legionellosis
c. Leptospirosis
d. Tetanus

Conditions due to Substances

a. Folliculitis
b. Acne
c. Asbestosis
d. Mesothelioma
e. Occupational Dermatitis
f. Occupational Asthma

The list above is not exhaustive and further advice should be sought from the project owner's health, safety and environment team when any staff member reports a work related disease.

Appendix L.

Sample Accident Reporting and Investigation Form

Are you reporting an Accident Resulting in an Injury		(✓)	**All Parts must be Completed**
Are you reporting a Dangerous Occurrence		(✓)	**Omit Parts HIJKM Only**

A) Person Details

Accident Report Number	FOR ADMIN USE		
Person Completing Form			
Date			

Personnel Number			
Surname			
Forenames			
Date of Birth		Age	
Home Address			
Postcode			
Work tel. No.			

Business	
Network Area	
Location	
Department	
Trade/Occupation	
Manager	
Supervisor	
Witness Name	
Tel. Number	

		✓		✓
Is person involved a:	Member of Public		Contractor	

B) Address of Accident ✓ Address details

	✓	Address details
Same as Business Location		
Elsewhere in organisation		
Someone else's property		
Public place		

C) Accident Details

Date of Accident	
Time of Accident	
Person in Charge	
Weather Conditions	

D) Description of Location e.g. workshop, office, switchroom, etc **E) Work Being Undertaken** e.g. Transformer installation

F) Shift Details

	✓		✓		✓
Normal day		Stand-By		Overtime	

Hrs Worked Prior to Accident (previous 14 days)	
Hrs Worked Prior to Accident (on day of accident)	

G) Accident Administration

		Date
Name of HSA Informed		
Accident book completed by		
HSE Report by		

H) Category

	✓		✓
Fatality		Major Injury	
Lost Time Accident		Non Lost Time Accident	
Over Three Day		Recurring Injury	

		✓		✓
Other Incident Forms Completed:	Road Transport Incident		Environmental Incident ENV-12-001	

I) Injury Type

	✓		✓		✓		✓
Abrasion	1	Concussion	6	Internal Wound	11	Burn	16
Amputation	2	Crushing	7	Shock	12	Chemical Splash	17
Asphyxiation/Poison/Fumes	3	Cut or Puncture	8	Septic Wound	13	Other	18
Break/Fracture	4	Dislocation	9	Sprain/Strain	14	Multiple Wound	
Bruising	5	Electric Shock	10	Foreign Body	15		

(Insert which side of body) ✓ ✓

For Multiple Wounds - state the relevant injury number from above, against **Part of Body** e.g. a 'crushing injury to the left thigh' = Tick **"Thigh"** left and enter the number **7** in **Injury No.** box.

J) Part of Body

	L	R	Injury
Buttocks/Pelvis			
Foot/Ankle/Toe			
Hand/Wrist			
Head & Neck			
Internal			
Side Torso			Use
Thigh			For
Lower Leg			Multiple
Stomach			Wound
Chest			Only
Back			
Arm			
Ear			
Eye			
Lip			
Finger			

K) Further Action:

As a result of the accident did the injured person:	Immediately ✓	Within 24hrs ✓	After 24hrs ✓	Not at all ✓
Become Unconscious				
Need Resuscitation				
Go to Hospital				
Local First Aid				
Home to Own GP				
Medical Centre/Nurse				
Sent/Went Home				
Occ. Health Referral				
Back to Work				
If the person went to hospital, for how long were they admitted?		Less than 24hrs(✓)	24-48hrs (✓)	48hrs+ (✓)

Briefly describe the main injury:	

L) Describe the Nature of the Accident

ACCIDENT INVESTIGATION

M) Main Cause

	✓		✓		✓
Animal		Trapped by collapse		Physical assault	
Contact boiling water		Handle, pull, lift & carry		Sharps	
Contact moving machinery		Harmful substance		Slip, trip or fall on flat	
Drowned or asphyxiated		Hit by moving object		Slip, trip or fall on stairs or steps	
Electricity		Hit by moving vehicle		Stretching	
Explosion		Hit by something stationary		Fire	
Fall from height (see opposi		How high was fall? me		Other: ( )	

N) Equipment/Substances

	✓	Describe further	ID Number	or Colour Code	
Electrical Plant				Date last inspected	
Mechanical plant				Date last inspected	
Vehicles				Date last inspected	
Hand Tools				Date last inspected	
Power Tools				Date last inspected	
Ladders/Scaffold				Date last inspected	
Substances				Coshh assessment	

O) PPE

	✓	Describe		✓	Describe
Helmet			Gloves		
Goggles			Boots/shoes		
Ear defenders			Suit		
Safety harness			Mask		
High visibility coat/vest			Other		

P) Job Instruction

	✓		✓		✓
Written		Verbal		None	

Q) Why did the accident happen?

some points for consideration: Safe systems of work Conditions under foot Access/egress Training Lighting Supervision Housekeeping Authorisation Utility records on site Defective Equipment Inspection regimes Risk Assessment	Attach as appropriate: sketch ✓ [ ] records ✓ [ ] photographs ✓ [ ] (If required continue on a separate sheet)

R) Remedial Action Required. (If the accident has resulted in an inquiry state this below)

Recommendations:	By Whom	Target Date

Injured Person's signature		Name		Date	
Safety Rep's signature		Name		Date	
Supervisor's signature		Name		Date	
Functional Manager's sign.		Name		Date	