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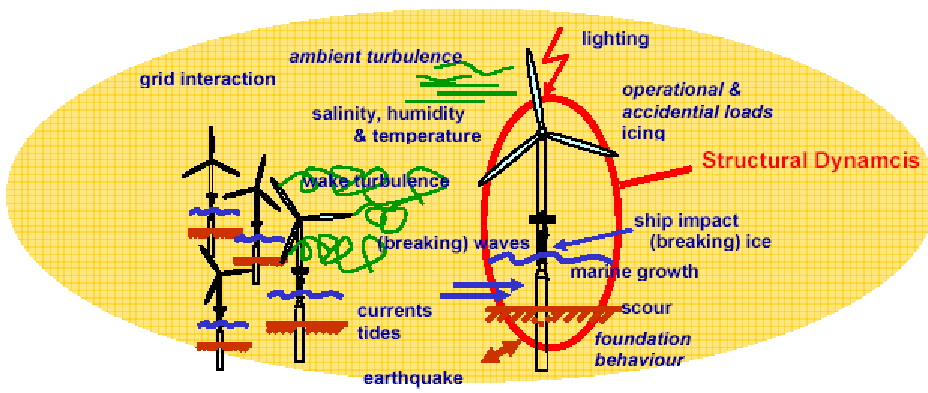
Workshop on the Role of the CVA for Offshore Wind Farms on the OCS



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BOEMRE SERVICE CONTRACT

Workshop on the Role of the CVA for Offshore Wind on the OCS

Front Page Acknowledgement–
Kuhn M. (2001), Dynamics and design optimization of OWECS, Institute for Wind Energy, Delft Univ. of Technology

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1. INTRODUCTION

A workshop was held at New Orleans on October 21-22, 2010 on the Role of the Certified Verification Agent (CVA) for Offshore Wind Structures.

The Bureau of Ocean Energy Management, Regulations and Enforcement (BOEMRE) requirements are set out in the Code of Federal Regulations Title 30, Part 285. The activities and amount of attendance/ surveillance, and the depth of examination as stipulated in the CFR are subject to interpretation. This workshop was intended to add some definition as to how best to fulfill the CVA role.

2. PURPOSE OF THE WORKSHOP

The purpose of the workshop was to produce a set of recommendations to BOEMRE from the workshop participants as to the detailed activities of the CVA for the design, fabrication and installation of wind energy structures on the Outer Continental Shelf of USA. The idea of the program at the workshop was to start with the degree, type and amount of surveillance to be carried out by the CVA for the various stages i.e. verification of design, fabrication, transportation & installation. The intention was that if the surveillance can be decided upon by the participants, then it may be an easier task to settle on the amount and type of calculation or check on calculations that can/should be done. The logical sequence of events starts with design, however, for the workshop it started from the transportation & installation phase and worked backwards. The reason for this was to tackle an easier problem first, get a "win" under our belts, and then tackle the more difficult issues.

3. DEFINITION OF THE CVA

Per 30 CFR §285, ***Certified Verification Agent (CVA)*** *means an individual or organization, experienced in the design, fabrication, and installation of offshore marine facilities or structures, who will conduct specified third-party reviews, inspections, and verifications in accordance with this part.*

The intent at the workshop was that we should discuss the activities to be reviewed for the CVA function, with the fact in mind that the CVA while paid for by the owner, is in the business of certifying for regulatory purposes (whatever we may perceive them to be). The production of the certification reports do not necessarily mean that the system will work, will be productive etc.: they are merely evidence that the structures and any components necessary for structural integrity are, in the opinion of the CVA , at the start of production, in compliance with appropriate regulatory requirements.

The specific citations in 30 CFR §285 pertaining to CVA activities are:
285.705 When Must I Use A Certified Verification Agent (CVA)?
285.706 How Do I Nominate A CVA For MMS Approval?
285.707 What Are The CVA's Primary Duties For Facility Design Review?

285.708 What Are The CVA's Or Project Engineer's Primary Duties For Fabrication And Installation Review?
285.709 When Conducting Onsite Fabrication Inspections, What Must The CVA Or Project Engineer Verify?
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285.714 What Records Relating To SAPs COPs And GAPs Must I Keep?

4. PLAN AND REPORT SUBMISSIONS TO BOEMRE

SAP - Site Assessment Plan – Is the plan that describes the process and related activities pertaining to meteorological or oceanographic site related data collection needed to characterize the commercial lease. CVA nomination or a request to waive the requirement for the CVA is made in this submittal. (30 CFR §285.610) (*Note: per 30 CFR 285.605(d), a CVA nomination is only required in the SAP if BOEMRE deems the facility or facilities (i.e., met tower) to be "complex or significant" – then the requirements of Subpart G apply which include the requirement for a CVA as well as the requirement for a Facility Design Report (FDR) and Fabrication & Installation Report (FIR))*.

COP – Construction and Operations Plan – The COP is the plan that describes the construction, operation and conceptual decommissioning activities for the commercial lease development demonstrating that the lessee is prepared to conduct the proposed activities. The CVA nomination or a request to waive the requirement for the CVA is made in this submittal (30 CFR §285.626).

GAP – General Activities Plan – The GAP describes the operator's planned activities for a limited lease, Right-of-Way (ROW) grant, or Right-of-Use and Easement (RUE) grant. It is submitted in lieu of a SAP and COP, and includes information similar to what is required in a SAP as well as additional information concerning planned activities throughout the term of the lease or grant. The CVA nomination or a request to waive the requirement for the CVA is made in this submittal (30 CFR §285.645). *(Note: per 30 CFR 285.645(c), a CVA nomination is only required in the GAP if BOEMRE deems the facility or facilities (i.e., met tower) to be "complex or significant" – then the requirements of Subpart G apply which include the requirement for a CVA as well as the requirement for a Facility Design Report (FDR) and Fabrication & Installation Report (FIR)).*

Facility Design Report and Fabrication and Installation Report – These are the Report(s) required to be submitted to the BOEMRE prior to fabrication and installation activities. For a SAP and GAP, a FDR and FIR are only required to be submitted if the facility or facilities are deemed by BOEMRE to be "complex or significant.

These reports are required to be **certified** by the CVA (or the Project Engineer – if appropriate BOEMRE waiver is obtained) to be in accordance with the approved SAP, COP and GAP as appropriate. (30 CFR §285.701). The CVA must certify in the Facility Design Report that the facility is designed to withstand the environmental and functional load conditions appropriate for the intended service life at the proposed location (30 CFR 285.707(a)). The CVA must certify in a separate report that the project components are fabricated and installed in accordance with accepted engineering practices; the approved SAP, COP, or GAP; and the Fabrication & Installation Report (30 CFR 285.708(a)(5)).

- You must use a CVA to review and certify the Facility Design Report (FDR), the Fabrication & Installation Report (FIR), and the Project Modifications & Repairs Report. (30 CFR 285.705)
- If you are required to use a CVA, the FDR must include one paper copy of the following certification statement: "The design of this structure has been certified by a MMS approved CVA to be in accordance with accepted engineering practices and the approved SAP, GAP, or COP as appropriate. The certified design and as-built plans and specifications will be on file at (given location)." (30 CFR 285.701(d))
- If you are required to use a CVA, the FIR must include one paper copy of the following certification statement: "The fabrication and installation of this structure has been certified by a MMS approved CVA to be in accordance with accepted engineering practices and the approved SAP, GAP, or COP as appropriate. The certified design and as-built plans and specifications will be on file at (given location)." (30 CFR 285.702(c))

4.1 CVA Activities

The CVA activities are stipulated in 30 CFR §285.705, which are as follows:

- Reviews and certifies the Facility Design Report, the Fabrication and Installation Report, and the Project Modifications and Repairs Report if applicable;
- Ensures facilities are designed, fabricated, and installed in accordance with accepted engineering practices and the above reports;
- Ensures repairs and modifications are performed per accepted engineering practice; and
- Provides BOEMRE with immediate reports of all incidents affecting design, fabrication and installation.

4.1.1 Design Review by CVA and Issues Related thereto:

The CVA Facility Design Review entails review of the design to ensure active and passive elements that affect structural integrity are designed as per the Facility Design Report. The specific details pertaining to the extent of the review by the CVA are addressed in the "Design CVA Activities" spread sheet in Appendix K- Facility Design Worksheet.

DNV provided a presentation to kick-off discussion of the Design Review by the CVA. It is found in Appendix E.

Key items of interest to the attendees that were discussed in more detail were based on and limited to only those that relate to the structure integrity and are as follows:

It has been recommended that the Design CVA attend a hazard identification workshop (HAZID) at the commencement of the design work, hosted by and for the benefit of the stakeholders to define the loads and load combinations and understand the design limitations and the risks being taken. This is particularly important on the East and Gulf Coasts of the United States because the hurricane loads and times for passing of hurricanes MAY not have been appropriately addressed in the IEC Code. Germanischer Lloyd has also seen fit to add some load cases in their Offshore Wind Certification requirements that have been seen as appropriate and they may add further ones to deal with tropical revolving storm areas.

There are a number of questions that were asked about the soil sampling e.g. reviewing the logs of activities and issues during sampling – BUT – it was noted that 30 CFR §285 does not require a CVA to be present during soil sampling activities. While there was some discussion that ensued out of interest at the workshop – it was not directly relevant to the currently stipulated CVA activities. It was noted that 30 CFR 250 mandated soil samples at each piling location within 500 feet, and some at the workshop were of the opinion that this requirement should apply to offshore wind farms. Items such as this were put onto a "parking lot" for later consideration either as a recommendation or as a point of discussion.

Another activity we struggled with was how the software that controls (for example: the yaw gears that are important to structural integrity) be examined. For the most part the software is proprietary and thus may not be able to be examined in detail except as a "black-box" and tested for functions, which may be initially anticipated at commissioning. It was necessary to define the activities of the CVA to verify the software. The yaw system and how to assure the electrical power to yaw continuously and with sufficient response in a given storm was discussed at length.

The requirements of the Part 1- Template for Structure, Equipment and Systems of this Study for the risk studies/meetings which can be found at http://www.boemre.gov/tarprojects/633.htm Report AD, are summarized below:

Provide a Failure Mode and Effect Analysis (FMEA) backed up where clarity for acceptance is required with a Quantitative Risk Analysis (QRA) to provide basis for extreme load cases. Particularly relevant will be any condition that relies upon power or the control system for tower survival. The QRA should analyze and summarize all conditions that could lead to tower or support structure failure and return period applicable to survival of the tower for each condition. The FMEA should identify all assumptions for which the structural integrity depends e.g. details of braking system if emergency stopping is safety critical: the loads will depend on assumptions made with *the deceleration value due to braking, and substantiation that this is a maintainable value may be critical; yaw angles used for calculating the load should be justified if safety critical; battery longevity may also be a safety critical assumption which should be disclosed.*

For both the wind towers and any transformer platform(s), provide details of collision criteria, and loads assumed in the derivation of an appropriate criteria: size of vessel appropriate, speed of collision, and other assumptions that determine the load value together with a copy of the HAZID or other rationale for determining the suitable size and speed. Provide details of collision design requirements, and protection requirements from collision e.g. fendering loads to prevent damage from attending vessels.

Provide copy of the HAZID conducted to decide the design issues with access.

- *The HAZID should contain information about the risks of health and safety for the type of access system being used e.g. Ladders (with fall arrest systems and intermediate platforms)*
- *Elevators*
- *Climb Assists*
- *Helicopters*

The HAZID ensures all stakeholders are on board with the definition of loads for the design.

Another key design issue that the workshop struggled with is whether the CVA's task is to repeat the calculations of the effects of loads (as is stipulated in the IEC Code), or merely to ensure that the results appear plausible/ sensible. If the Type Certifier or Project Certifier has carried out such an independent analysis, it was asked if this would be sufficient for purposes of the CVA.

The recommended design requirements listed in Part 1 were used as the basis of a modified list found in Appendix K. The workshop participants reviewed this document line by line, and adjustments were made to the text to satisfy comments that were made.

Appendix K Design CVA Worksheet lays out the Items of Proposed Design Information, followed by the Proposed CVA activity in Design. (This may vary somewhat as a result of the owner's proposal to BOEMRE in the Facility Design Report). The proposed CVA Activity notes whether there is no activity because it is not a CVA duty, and if it is a CVA duty notes the activity.

4.1.2 Fabrication Review by CVA and Related Issues

The CVA's duties for Fabrication and Installation review are stated in 30 CFR §285.708. The CVA surveillance activities related to Fabrication, Loadout –Transportation – Lifting and Installation are tabulated in the spread sheet "Surveillance CVA Activities" in Appendix J "CVA Worksheet Loadout/Transportation/Installation and Commissioning.

Special topics that evoked additional discussions amongst the participants are described below.

For the Fabrication CVA – for the oil and gas industry there are often 3 or 4 main components to the structure, thus the CVA can examine the fabrication quality control system at a limited number of sites and spot-check the documentation, providing samples to augment the CVA Report to BOEMRE. That activity is much more difficult for offshore windfarm structures with multiple components from multiple suppliers, many of which affect the structural integrity and which only come together in the marshalling yard (port from which the installation proceeds). Type Certificates, Manufacturing Certificates and variety of other Certificates have been typically used in the wind turbine business for components; however, serial failures have resulted from items that are Certified. It is also important to know the underlying standard used upon which the Certificate was based. For components (e.g. a blade), the Type Certificate may only cover, the certification of the first component (prototype) off the assembly line, and (often but not always) a Manufacturing Certificate confirmation that the quality system can produce carbon copies of the tested prototype for at least a year (before a visit is made to confirm for another year). A test may be carried out or may be omitted by agreement. For logistical, timing and cost reasons it is probable that the blade (and other parts) will come as a Type Certified system. Our workshop's task was to define the activity of the CVA and what should be done in the way of checks. One possible outcome was that the CVA should examine the basis of the Type Certification i.e. to ensure that the fabricated component reflects acceptability with the underlying standard. If no other Certifier has endorsed the component for the site activities (e.g. Project Certifier) then the CVA examines any tests carried out on the component to ensure that the tests did not reveal characteristics that would make the component inappropriate to the site. The attendance at the test would not be necessary if the equipment had a Type Certification. If, however, the component is delivered without a Type Certificate then the CVA should have to go through a similar process to Type Certification to confirm the necessary pre-verification documentation to proceed with the CVA activities.

Fabrication activities may apply to the following components. The activities were considered by the workshop participants:

Tower	Tower Foundation	Blades
Bolt Connections	Coating	Cathodic Protection
Control Monitoring	Fire Suppression	Lightning Protection
Gearbox	Yaw system	Pitch system
Drive Train	Brakes and Locking Devices	Hydraulic System
HVAC	Generator incl. Bearings	Transformers,
Battery Charging Equip.	Battery	J-Tubes & Landings
Switchgear & Protection Eq.	Transformer Station Cables	Nacelle Cover
Spinner Housing	Nacelle Frame	In-Field Cables
Cables to shore	Structure of Crane (if fitted)	Nav. Lights.

Note: a complete set of likely components for the CVA's attention is found in the Part 1-Template for Structure, Equipment and Systems Section 1.4, which can be found at http://www.boemre.gov/tarprojects/633.htm Report AD.

The CVA activities were limited to only those that relate to the structure integrity.

Bureau Veritas made a presentation on Fabrication CVA Activities and this presentation is provided in Appendix F.

Listed in Appendix J is a set of proposed surveillance activities to be performed by the CVA. The workshop participants reviewed this document line by line, and adjustments were made to the text to satisfy comments that were made.

Appendix J Surveillance CVA Activities lays out the list of major components making up the wind farm. The definitions of those items are given in the cover sheet to Appendix J. Two different options were proposed to satisfy the fabrication CVA requirement: one where the equipment arrived at site with a Type Certification and one where it did not. Separate proposed activities were listed for Loadout-Transportation-Lifting, for Installation, and for Commissioning. (This may vary somewhat as a result of the owner's proposal to BOEMRE in the Facility Design Report). The proposed CVA Activity notes whether there is no activity (-NA-) because it is not a CVA duty. Items and explanations are added as appropriate.

4.1.3 Transportation/ Loadout /Installation Review by CVA and Related Issues

In regard to transportation, for oil and gas platforms the CVA attends at the site of departure of the completed base structure from the shipyard, attends at arrival at final location in the OCS, inspects and notes any damage from the voyage, and notes the captain's log from the transportation to confirm there has been no overload due to motions. The CVA attends the installation but there is no prescriptive tasks other than to observe compliance with approved installation process and report damage so that the damage can be appropriately repaired (if applicable), and that at the time of start-up the oil and gas facility is "intact" as per the design.

In regard to transportation, the offshore wind farm CVA's task may be somewhat more complex. Multiple components are transported to site from multiple locations around the world. The inspection prior to departure and upon arrival for each component and examination of both marine logs and trucker logs would be an expensive duplication of the quality system documentation that may (should) take place. It was thus important to discuss what extent should a CVA be involved in the transportation of each blade to the marshalling yard, and from the marshalling yard to site; and for the turbine structure, turbine, gear boxes, cabling etc. The workshop tackled these issues with the initial proposal that the work of the CVA on transportation starts at the marshalling yard. If this was not to be the case, it would probably be necessary to ensure logs of daily activities are produced in order to verify the motions of the components that undergo during transportation. It is noted that the IEC Code calls for a certification of the documentation that the manufacturer produces to state the limitations on the equipment and tiedowns etc. However, the IEC does not stipulate a way to see if an actual overload took place with the equipment en route to the final location. Our start point was to look for each component as to what the transportation CVA should do in the way of surveillance, and in the way of auditing the paperwork.

Loadouts were part of the discussion. There are so many items loaded out with the numerous components that after discussion it was deemed appropriate that the method of loadout be checked by the CVA against the manufacturer requirements with a plausibility check, and ensuring the manufacturer's documents were followed to the extent that structural integrity of the final project depended on them. The CVA could observe some of those loadouts as appropriate as a spot check.

For installation it was necessary to carefully define the activities of the CVA. The blades and tower structure are usually bolted into place. The questions facing the workshop were:

- Should the CVA check the torque on every bolt?
- Spotcheck the bolt torque? Or
- Just ensure that torque wrenches are being used and that there is a procedure for using and calibrating them? Since the CVA probably needs to examine daily logs of torques, then it is necessary to mandate that those are recorded.
- Should the alignment of the tower pieces be checked to ensure they fit together without gaps as the tolerance needs to be tight?
- To what extent does the CVA need to ensure that the electric submarine cable is terminated properly?
    - That the installation into the J-tube does not damage the cable?
    - That the J-tube itself is robust to protect the cable (more of a design issue)?
    - That the cable laying itself is observed by the CVA to ensure there is not potentially damaged area?

  Although the cable is not typically part of a structural integrity check, if the turbine structural capability depends on the ability of the structure to yaw, then it may be important (depending on battery life, and likely duration of storm), that the cable is intact to protect the structure against collapse.
- How much should the CVA be physically present at site observing the installation? Should he be there for each pile nailed into place?
    - A representative number of piles?
    - Or just at the first one, part way through and final one?
    - Should he examine documentation i.e. logs of daily activities to assess the acceptability of the driven piles? (then there needs to be a requirement to actually keep logs).

Commissioning was proposed as part of the installation activity e.g. software for control, shut down in high winds, backup to the yaw system etc. and thus became part of the discussion.

The American Bureau of Shipping made a presentation on Loadout/ Transportation/ Installation and Commissioning activities and this presentation is provided in Appendix G.

Note remarks on Appendix J which also applies to this section, and which are contained in 4.1.2.

5. CVA QUALIFICATIONS AND STIPULATED ACTIVITIES

5.1 Qualifications.

Qualifications for the CVA for Offshore Wind Farms are given in 30 CFR §285.706. Two key components are:

- *Individuals or organizations acting as CVAs must not function in any capacity that will create a conflict of interest, or the appearance of a conflict of interest.*
- *The verification must be conducted by or under the direct supervision of registered professional engineers.*

The CVA's primary duties for facility design review are included in 30 CFR §285.707:

- *The CVA must certify in the Facility Design Report to MMS that the facility is designed to withstand the environmental and functional load conditions appropriate for the intended service life at the proposed location.*
- *The CVA must conduct an independent assessment of all proposed …Load Determinations as well as assessing other aspects of the design.*

The CVA's primary duties for conducting onsite fabrication inspections include in 30 CFR 285.709 the requirement to verify:

- *"Quality control by lessee (or grant holder) and builder;*
- *Fabrication site facilities;*
- *Material quality and identification methods;*
- *Fabrication procedures specified in the Fabrication and Installation Report, and adherence to such procedures;*
- *Welder and welding procedure qualification and identification;*
- *Structural tolerances specified and adherence to those tolerances;*
- *The nondestructive examination requirements, and evaluation results of the specified examinations;*
- *Destructive testing requirements and results;*
- *Repair procedures;*
- *Installation of corrosion-protection systems and splash-zone protection;*
- *Erection procedures to ensure that overstressing of structural members does not occur;*
- *Alignment procedures;*
- *Dimensional check of the overall structure, including any turrets, turret-and-hull*
- *interfaces, any mooring line and chain and riser tensioning line segments; and*
- *Status of quality-control records at various stages of fabrication"….etc.*

The CVA role in carrying out some of these tasks for the component parts such as blades, nacelles etc all of which may come from component stock and thus not being manufactured specifically for the designated location were to be part of our discussion. The various parts may come from multiple sources making the specific equipment certification process expensive compared to the type certification process.

The IEC indicates that blade testing is of key importance to assuring that blades do not break off and cause injuries etc., yet there is no specifics in the CFRs about tests to be done or indeed if any are required. This like many other items in the CFR is provided with no specifics about how to certify and indeed in 30 CFR 285.708 it is left to the CVA (or project engineer) to *"use good engineering judgment and practice in conducting and independent assessment of the fabrication and installation facilities"*. We thus tried to define this in the workshop.

The CVA functions 30 CFR §285.710 include: verify, survey, witness, survey or check the following items during facility installation:

- *Loadout and initial flotation activities;*
- *Towing operations to the specified location, and review the towing records;*
- *Launching and up righting activities;*
- *Submergence activities;*
- *Pile or anchor installations;*
- *Installation of mooring and tethering systems;*
- *Final deck and component installations; and*
- *Installation at the approved location according to the Facility Design Report and the Fabrication and Installation Report"* etc.

It should be of note that although software is not mentioned nor the subsea cables, if the structural integrity of the towers depends on those, then it should be and was part of any discussion as to the extent of verification and surveillance.

5.2 Information on the CVA role in Offshore Wind Farms is stipulated in the Code of Federal Regulation (30 CFR §285).

§285.707 What are the CVA's primary duties for facility design review?

If you are required to use a CVA:

(a) The CVA must use good engineering judgment and practices in conducting an independent assessment of the design of the facility. The CVA must certify in the Facility Design Report to MMS that the facility is designed to withstand the environmental and functional load conditions appropriate for the intended service life at the proposed location.

(b) The CVA must conduct an independent assessment of all proposed:

[1]. Planning criteria;

[2]. Operational requirements;

[3]. Environmental loading data;

[4]. Load determinations;

[5]. Stress analyses;

[6]. Material designations;

[7]. Soil and foundation conditions;

[8]. Safety factors; and

[9]. Other pertinent parameters of the proposed design.

(c) For any floating facility, the CVA must ensure that any requirements of the U.S. Coast Guard for structural integrity and stability (e.g., verification of center of gravity), have been met. The CVA must also consider:

[1]. Foundations, foundation pilings and templates, and anchoring systems; and

[2]. Mooring or tethering systems.

§285.708 What are the CVA's or project engineer's primary duties for fabrication and installation review?

(a) The CVA or project engineer must do all of the following:

[1]. Use good engineering judgment and practice in conducting an independent assessment of the fabrication and installation activities;

[2]. Monitor the fabrication and installation of the facility as required by paragraph (b) of this section;

[3]. Make periodic onsite inspections while fabrication is in progress and verify the items required by § 285.709;

[4]. Make periodic onsite inspections while installation is in progress and satisfy the requirements of § 295.7 10; and

[5]. Certify in a report that project components are fabricated and installed in accordance with accepted engineering practices; your approved COP, SAP, or GAP (as applicable); and the Fabrication and Installation Report.

i. The report must also identify the location of all records pertaining to fabrication and installation, as required in § 285.7 14(c); and

ii. You may commence commercial operations or other approved activities 30 days after MMS receives that certification report, unless MMS notifies you within that time period of its objections to the certification report.

(b) To comply with paragraph (a)(5) of this section, the CVA or project engineer must monitor the fabrication and installation of the facility to ensure that it has been built and installed according to the Facility Design Report and Fabrication and Installation Report.

[1]. If the CVA or project engineer finds that fabrication and installation procedures have been changed or design specifications have been modified, the CVA or project engineer must inform you; and

[2]. If you accept the modifications, then you must also inform MMS.

§ 285.709 When conducting onsite fabrication inspections, what must the CVA or project engineer verify?

(a) To comply with § 285.708(a)(3), the CVA or project engineer must make periodic onsite inspections while fabrication is in progress and must verify the following fabrication items, as appropriate:

[1]. Quality control by lessee (or grant holder) and builder;

[2]. Fabrication site facilities;

[3]. Material quality and identification methods;

[4]. Fabrication procedures specified in the Fabrication and Installation Report, and adherence to such procedures;

[5]. Welder and welding procedure qualification and identification;

[6]. Structural tolerances specified, and adherence to those tolerances;

[7]. Nondestructive examination requirements and evaluation results of the specified examinations;

[8]. Destructive testing requirements and results;

[9]. Repair procedures;

[10]. Installation of corrosion-protection systems and splash-zone protection;

[11]. Erection procedures to ensure that overstressing of structural members does not occur;

[12]. Alignment procedures;

[13]. Dimensional check of the overall structure, including any turrets, turret-and-hull interfaces, any mooring line and chain and riser tensioning line segments; and

[14]. Status of quality-control records at various stages of fabrication.

(b) For any floating facilities, the CVA or project engineer must ensure that any requirements of the U.S. Coast Guard for structural integrity and stability (e.g., verification of center of gravity) have been met. The CVA or project engineer must also consider:

[1]. Foundations, foundation pilings and templates, and anchoring systems; and

[2]. Mooring or tethering systems.

§ 285.710 When conducting onsite installation inspections, what must the CVA or project engineer do?

To comply with § 285.708(a)(4), the CVA or project engineer must make periodic onsite inspections while installation is in progress and must, as appropriate, verify, witness, survey, or check, the installation items required by this section.

(a) The CVA or project engineer must verify, as appropriate, all of the following:

[1]. Loadout and initial flotation procedures;

[2]. Towing operation procedures to the specified location, and review the towing records;

[3]. Launching and uprighting activities;

[4]. Submergence activities;

[5]. Pile or anchor installations;

[6]. Installation of mooring and tethering systems;

[7]. Final deck and component installations; and

[8]. Installation at the approved location according to the Facility Design Report and the Fabrication and Installation Report.

(b) For a fixed or floating facility, the CVA or project engineer must verify that proper procedures were used during the following:

[1]. The loadout of the jacket, decks, piles, or structures from each fabrication site; and

[2]. The actual installation of the facility or major modification and the related installation activities.

(c) For a floating facility, the CVA or project engineer must verify that proper procedures were used during the following:

[1]. The loadout of the facility;

[2]. The installation of foundation pilings and templates, and anchoring systems; and

[3]. The installation of the mooring and tethering systems.

(d) The CVA or project engineer must conduct an onsite survey of the facility after transportation to the approved location.

(e) The CVA or project engineer must spot-check the equipment, procedures, and recordkeeping as necessary to determine compliance with the applicable documents incorporated by reference and the regulations under this part.

5.3 CVA for Oil and Gas Structures –from 30 CFR §250.909 – 918.

For comparison and as background the following information summarizes the requirements for certain oil and gas equipment.

Design CVA: Conduct an independent assessment:

(i) Planning criteria;
(ii) Operational requirements;
(iii) Environmental loading data;
(iv) Load determinations;
(v) Stress analyses;
(vi) Material designations;
(vii) Soil and foundation conditions;
(viii) Safety factors; and
(ix) Other pertinent parameters of the proposed design.

Fabrication CVA: Make periodic onsite inspections while fabrication is in progress and must verify the following fabrication items, as appropriate:

(i) Quality control by lessee and builder;
(ii) Fabrication site facilities;
(iii) Material quality and identification methods;
(iv) Fabrication procedures specified in the approved plan, and adherence to such procedures;
(v) Welder and welding procedure qualification and identification;
(vi) Structural tolerances specified and adherence to those tolerances;
(vii) The nondestructive examination requirements, and evaluation results of the specified examinations;
(viii) Destructive testing requirements and results;
(ix) Repair procedures;
(x) Installation of corrosion- protection systems and splash-zone protection;
(xi) Erection procedures to ensure that overstressing of structural members does not occur;
(xii) Alignment procedures;
(xiii) Dimensional check of the overall structure, including any turrets, turret-and-hull interfaces, any mooring line and chain and riser tensioning line segments; and
(xiv) Status of quality-control records at various stages of fabrication.

Primary duties of the CVA during the installation phase include the following:

Verify, as appropriate:

(i) Loadout and initial flotation operations;
(ii) Towing operations to the specified location, and review the towing records;
(iii) Launching and uprighting operations;
(iv) Submergence operations;
(v) Pile or anchor installations;
(vi) Installation of mooring and tethering systems;
(vii) Final deck and component installations; and

(viii) Installation at the approved location according to the approved design and the installation plan.

Witness

(i) The loadout of the jacket, decks, piles, or structures from each fabrication site;
(ii) The actual installation of the platform or major modification and the related installation activities.

Conduct an onsite survey of the platform after transportation to the approved location.

Spot-check as necessary to determine compliance with the applicable document listed as standards (references are noted in the CFR) for:

(i) Equipment;
(ii) Procedures; and
(iii) Recordkeeping.

*Please note when referring to CVA that "he" above may also be "she".

Further more detailed discussion can be found on this subject at http://www..gov/tarprojects/633.htm Report AE.

6. RESULTS

The results of the workshop are the Worksheets showing the generally agreed opinion of the participants (not always unanimous) as to the general approach recommended for the CVA activities. These are broken down to two appendices. The Recommendations from the workshop are given in Appendix L. The participants are listed in Appendix M.

Appendix J Surveillance CVA Activities lays out the list of major components making up the wind farm. The definitions of those items are given in the cover sheet to Appendix J. Two different options were proposed to satisfy the fabrication CVA requirement: one where the equipment arrived at site with a Type Certification and one where it did not. Separate proposed activities were listed for Loadout-Transportation-Lifting, for Installation, and for Commissioning. (This may vary somewhat as a result of the owner's proposal to BOEMRE in the Facility Design Report). The proposed CVA Activity notes whether there is no activity (-NA-) because it is not a CVA duty. Items and explanations are added as appropriate.

Appendix K Design CVA Worksheet lays out the Items of Proposed Design Information, followed by the Proposed CVA activity in Design. (This may vary somewhat as a result of the owner's proposal to BOEMRE in the Facility Design Report). The proposed CVA Activity notes whether there is no activity because it is not a CVA duty, and if it is a CVA duty notes the activity.

APPENDIX A: AGENDA

BOEMRE
OFFSHORE WIND CVA WORKSHOP
AGENDA
10/19/10

Thursday, October 21

7:00 – 8:00 a.m.
Registration - Coffee and Croissants provided

MORNING SESSION

8:00 – 8:15 a.m.
Welcome: Introductions – (round the room) – Name, & Affiliation.

Overview of Desired Workshop Outcome-
- Briefing by John Cushing & Lori Medley

8:15 – 9:00 a.m.

"***CVA Expected Activities- Surveillance and Design"***
- Malcolm Sharples, Offshore Risk & Technology Consulting, Inc.

9:00 – 9:45 a.m.
"***GL Thoughts on CVA Activities and Surveillance for Offshore Wind Farms"***
C. Todd Wynn - (Confirmed but title not confirmed)

9:45- 10:30
"***DNV Thoughts on CVA Process for Offshore Wind Farm Design Activities"***
Kim Mørk - DNV Energy

10:30 – 10:45 a.m.
Coffee Break

10:45- 11:30 a.m.
"***BV Thoughts on CVA Process for Offshore Wind Farm Fabrication"***
Kevin Wedman BV (Title to be confirmed)

11:30 – 12:15 noon.

"***ABS Thoughts on CVA Process for Offshore Wind Farm Surveillance Transportation, & Installation"***
Luiz Feijo (Title not confirmed)

12:15-1:00 Lunch

1:00 – 2:00 pm

KEYNOTE PRESENTATION

"Certification of the complete project: How to deal with the uncertainties and with site specific turbine certification" – Jaap Olthoff – Olthoff Wind Group BV, The Netherlands.

WORK SESSION 1:
2:00-2:15
"CVA Activities with Transformer Platform- A Quick Review"
(same as oil and gas CVA)
– Partha Ganguly – Millennium Technical Consultants Inc.

2:15- 4:30.
Surveillance during Fabrication, Loadout/Transportation/Lifting and Installation/Commissioning Phases – Wind Turbine Structures etc.

Facilitator: Kent Dangtran, DOTC LLC Participation: All
Materials: Table of Proposed Surveillance Activities to be Commented on/ Changed by discussion.

3:00 pm – 3:30 pm
Refreshment Break

4:30 – 5:15 p.m.
PARKING LOT ISSUES Part 1:

Facilitator: Malcolm Sharples Participation: All

Friday, October 22

7:00 – 8:00 a.m.- Coffee & Croissants

8:00 – 9:30 a.m.
WORK SESSION 2: ***Design CVA Review Activities.***

Facilitator: Malcolm Sharples Participation: All
Materials: Table of Proposed CVA Design Review Activities to be Commented on/ Changed by discussion.

9:30 – 10:00 a.m.
Coffee Break

10:00 – 11:45 a.m.

WORK SESSION 3: Recommendations to BOEMRE from Workshop Discussions.

Parking Lot Session – Part 2

HAZID Sessions – Load Cases – How, What, When
CVA Role in Return Period etc. Construction/ Installation Activities
CVA Role in Return Period etc. Design
CVA Role – in HAZID
BOEMRE Role – in HAZID

Qualifications of CVA –
-Qualifications of "Type Certifier" / Proj. Engr. as CVA

Other Items

Facilitators: Malcolm Sharples/Kent Dangtran Participation: All

12:00 – 12:45 p.m.
Lunch Break

12:45 p.m. - 2 p.m.
General Discussion plus Questions and Answers.

2:00 p.m.
ADJOURN

2:00 – 3:30 Wrap up of Notes etc. by sponsors and facilitators prior to departing.

APPENDIX B: BOEMRE Background Info and Workshop Goals

by John Cushing, BOEMRE

TAR Project #633
CVA Workshop

Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE)

John Cushing
BOEMRE
21 October 2010

BOEMRE requirements for Offshore Wind Projects

Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE)

30 CFR 285 – "Renewable Energy & Alternate Uses of Existing Facilities on the OCS"

- Subpart A – General Provisions
- Subpart B – Issuance of Leases
- Subpart C – Rights of Way Grants/Easements
- Subpart D – Lease & Grant Administration
- Subpart E – Payments & Financial Assurance
- Subpart F – Plans & Information Requirements
- Subpart G – Facility Design, Fabrication, & Installation (incl. CVA requirements)
- Subpart H – Env. & Safety Management, Inspections, & Facility Assessments

Leasing & Payments

Plans & Inspections

BOEMRE requirements for Offshore Wind Projects

Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE)

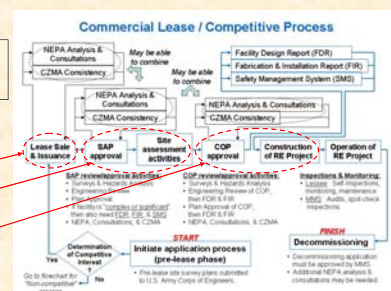
30 CFR 285 – "Renewable Energy & Alternate Uses of Existing Facilities on the OCS"

- No specific design requirements for:
  - ✓ Met towers,
  - ✓ Wind turbines,
  - ✓ Transformer platforms,
  - ✓ Subsea cables.
- No specific requirements for equipment or workplace safety & health.
- BOEMRE intends to use "design basis" approach for review/approval of offshore wind projects.
- BOEMRE regs include CVA requirements in Subpart G (30 CFR 285.705 to .712).

BOEMRE requirements for Offshore Wind Projects

Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE)

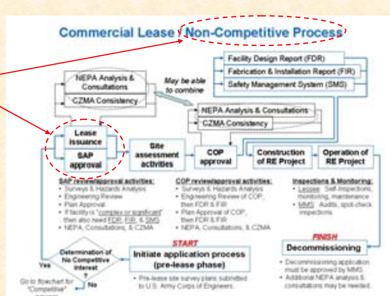
Comprehensive regulatory process, per 30 CFR 285



BOEMRE requirements for Offshore Wind Projects

Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE)

There is also a "Non-Competitive" process, which is more streamlined



BOEMRE requirements for Offshore Wind Projects

Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE)

Certified Verification Agent (CVA):

- CVAs are independent companies employing Professional Engineers with appropriate quals & experience to conduct third-party reviews.
- CVAs have been used in review/approval process for offshore oil & gas structures since the 1980s.
- CVAs provide independent third-party review of:
  - ✓ Design
  - ✓ Fabrication
  - ✓ Installation

- CVAs should not have been involved in any original design work (working for developer) if they are to perform any design, fabrication, or installation CVA duties (oversight of developer).
- CVA is nominated/retained by developer, but performs reviews for and reports directly to MMS.

BOEMRE requirements for Offshore Wind Projects

Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE)

CVA (continued):

- CVA regulations…
  - ✓ Offshore Oil & Gas Structures (Platform Verification Program): 30 CFR 250.909 - .918
  - ✓ Offshore Renewable Energy Projects: 30 CFR 285.705 - .712
- "Qualification statement" must be submitted to nominate CVA:
  1. Previous experience with similar structures
  2. Technical capabilities of staff
  3. Size/type of organization
  4. Availability of appropriate technology (hardware, software, etc.)
  5. Ability to perform CVA functions for specific project
  6. Previous experience with MMS requirements/procedures
  7. Level of work to be performed by CVA

To address at this workshop!

BOEMRE requirements for Offshore Wind Projects

Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE)

CVA Duties – DESIGN (30 CFR 285.707):

- Use good engineering judgment & practices to conduct an independent assessment of the design.
- Certify that facility is designed to withstand environmental & functional loads for intended service life.
- Conduct an independent assessment of all proposed:
  1) Planning criteria,
  2) Operational requirements,
  3) Environmental loading data,
  4) Load determinations,
  5) Stress analysis,
  6) Material designations,
  7) Soil & foundation conditions,
  8) Safety factors, and
  9) Other pertinent parameters of the proposed design.
- For floating facilities, the CVA must ensure any USCG requirements for structural integrity and stability are met, and must consider:
  1) Foundations, foundation pilings & templates, and anchoring systems, and
  2) Mooring or tethering systems.

BOEMRE requirements for Offshore Wind Projects

Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE)

CVA Duties – FABRICATION (30 CFR 285.708 and .709):

- Use good engineering judgment & practice to conduct an independent assessment of the fabrication activities.
- Monitor fabrication to ensure structure is built in accordance with the FDR & FIR.
- Make periodic onsite inspections during fabrication to verify, as applicable:
  1) Quality control by lessee and builder,
  2) Fabrication site facilities,
  3) Material quality & identification methods,
  4) Fabrication procedures in FIR are being adhered to,
  5) Welder & welding procedure qualification & identification,
  6) Structural tolerances specified and adhered to,
  7) Nondestructive examination requirements and evaluation of results,
  8) Destructive testing requirements and results,
  9) Repair procedures,
  10) Installation of corrosion-protection systems & splash-zone protection,
  11) Erection procedures to ensure overstressing of structural mbrs doesn't occur,
  12) Alignment procedures,
  13) Dimensional check of overall structures, including any mooring lines, and
  14) Status of quality control records at various stages of fabrication.

BOEMRE requirements for Offshore Wind Projects

Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE)

CVA Duties – FABRICATION (continued):

- For floating facilities, the CVA must ensure any USCG requirements for structural integrity and stability are met, and must consider:
  1) Foundations, foundation pilings and templates, and anchoring systems, and
  2) Mooring or tethering systems.
- Certify in a report that project components are fabricated in accordance with:
  1) Accepted engineering practices;
  2) Approved COP, SAP, or GAP; and
  3) Fabrication & Installation Report (FIR).

BOEMRE requirements for Offshore Wind Projects

Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE)

CVA Duties – INSTALLATION (30 CFR 285.708 and .710):

- Use good engineering judgment & practice to conduct an independent assessment of the installation activities.
- Monitor installation to ensure structure is installed in accordance with FDR & FIR.
- Make periodic onsite inspections during installation to verify, witness, survey, or check, as applicable:
  1) Loadout & initial flotation procedures,
  2) Towing operation procedures to specified location, and review of towing record,
  3) Launching & uprighting activities,
  4) Submergence activities,
  5) Pile or anchor installations,
  6) Installation of mooring and tethering systems,
  7) Final deck & component installations, and
  8) Installation at the approved location according to FDR & FIR
- For a fixed or floating facility, the CVA must verify that proper procedures were used during:
  1) Loadout of the jacket, decks, piles, or structures from each fabrication site, and
  2) Actual installation of the facility or any major modifications and the related installation activities.

BOEMRE requirements for Offshore Wind Projects

Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE)

CVA Duties – INSTALLATION (continued):

- For floating facilities, the CVA must verify proper procedures were used during:
  1) Loadout of the facility,
  2) Installation of foundation pilings & templates, and anchoring systems, and
  3) Installation of mooring & tethering systems.
- Certify in a report that project components are installed in accordance with:
  1) Accepted engineering practices;
  2) Approved COP, SAP, or GAP; and
  3) Fabrication & Installation Report (FIR).

General Thoughts

Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE)

Risks:

- Need to take conservative approach, because many unknowns:
  - ✓ Environmental loadings (especially hurricanes) are big "wild card."
  - ✓ Subsea soil conditions & scour not well known in "frontier areas."
- Need to consider the impact of catastrophic failures, especially when a design flaw could lead to the failure of many structures:
  - ✓ Human Risk (unmanned structures) – Low
  - ✓ Environmental Risk (minimal oil storage) – Low
  - ✓ Power Supply Risk (disruption of electricity to grid) – Medium?
  - ✓ Industry Risk (credibility for growth of new industry) – High?

Standards:

- Preference is to use U.S. standards whenever possible.
- European or International standards should be considered when there are shortcomings or gaps.

General Concept

Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE)

European offshore wind experience

U.S. offshore oil & gas experience

U.S. land-based wind experience

U.S. offshore wind program

Projects relating to CVA role

Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE)

Marine Board:

- Conducted a CVA Workshop for BOEMRE in March 2010.
- Conducting a Follow-on Study to be completed by Feb 2011.
- Workshop & study to provide general feedback to BOEMRE regarding:
  - ✓ CVA qualifications
  - ✓ CVA role
  - ✓ Standards for U.S. offshore wind farms

AWEA:

- AWEA's "Large Wind Turbine Standards 'Roadmapping' Workgroup" has met 3 times (Oct 2009, May 2010, and Oct 2010).
- Goal is to complete draft guidance by Dec 2010, and final guidance by Dec 2011.
- Focus: Standards for U.S. wind turbines – both land-based & offshore.

TAR Project #633:

- Includes this workshop to clarify CVA role.

Questions?

APPENDIX C: CVA Expected Activities: Surveillance and Design

by Malcolm Sharples, Offshore Risk & Technology Consulting Inc,

Offshore Wind Workshop

CVA Expected Activities: Surveillance and Design

on the OCS

Bureau of Ocean Energy Management, Regulation and Enforcement

Offshore Risk & Technology Inc.

Malcolm Sharples

1

Welcome to the Offshore Wind Workshop – Many of the functions that I have been to on Offshore Wind have been entertaining, which I hope this one is too….however, our main purpose here is to WORK, THINK, DISCUSS and COME TO a set of RECOMMENDATIONS for the BOEMRE on the role of the Certified Verification Agent on the OCS.

We all, in this room at least, are all probably on board with the fact that wind power will be part of the electricity mix going forward for the United States

Global Growth seems to be inevitable.

Growth Appears Inevitable

In terms of wind power, USA has the highest installed capacity and it growth each year is amazing. For offshore wind the U.K. now leads ahead of Denmark who installed the first wind turbines offshore. There have been a lot of lessons learned thanks to the research carried out in Denmark and in Europe. The amount of funds spent in research is far more than has been or is being spent in the United States. The Europeans have been working on this technology for decades. It will not be easy to play catch up. Our issue here is to help define the roadmap to the regulatory process for offshore wind farms.

Growth Appears Inevitable

Position 2009	Country	Total Offshore Capacity [MW] end 2009	New Offshore Capacity [MW] installed in 2009	Total Offshore Capacity [MW] end 2008	Rate of Growth [%]
1	United Kingdom	688,0	104,0	574,0	18,1
2	Denmark	663,6	237,0	426,6	55,6
3	Netherlands	247,0	0,0	247,0	0,0
4	Sweden	164,0	30,0	134,0	22,4
5	Germany	72,0	60,0	12,0	500,0
6	Belgium	30,0	0,0	30,0	0,0
7	Finland	30,0	0,0	30,0	0,0
8	Ireland	25,0	0,0	25,0	0,0
9	China	23,0	21,0	2,0	1050,0
10	Spain	10,0	0,0	10,0	0,0
11	Norway	2,3	2,3	0,0	/
12	Japan	1,0	0,0	1,0	0,0
	TOTAL	1955,9	454,3	1491,6	30,5

Ref: World Wind Energy Association wwec2010.com

The table presented for both the current capacity for offshore wind and rate of growth is given based on the World Wind Energy Association data. We are also aware that China is looking at offshore wind, around Bohai Bay, so they will soon be an important force in this market.

This is NOT your O&G CVA!

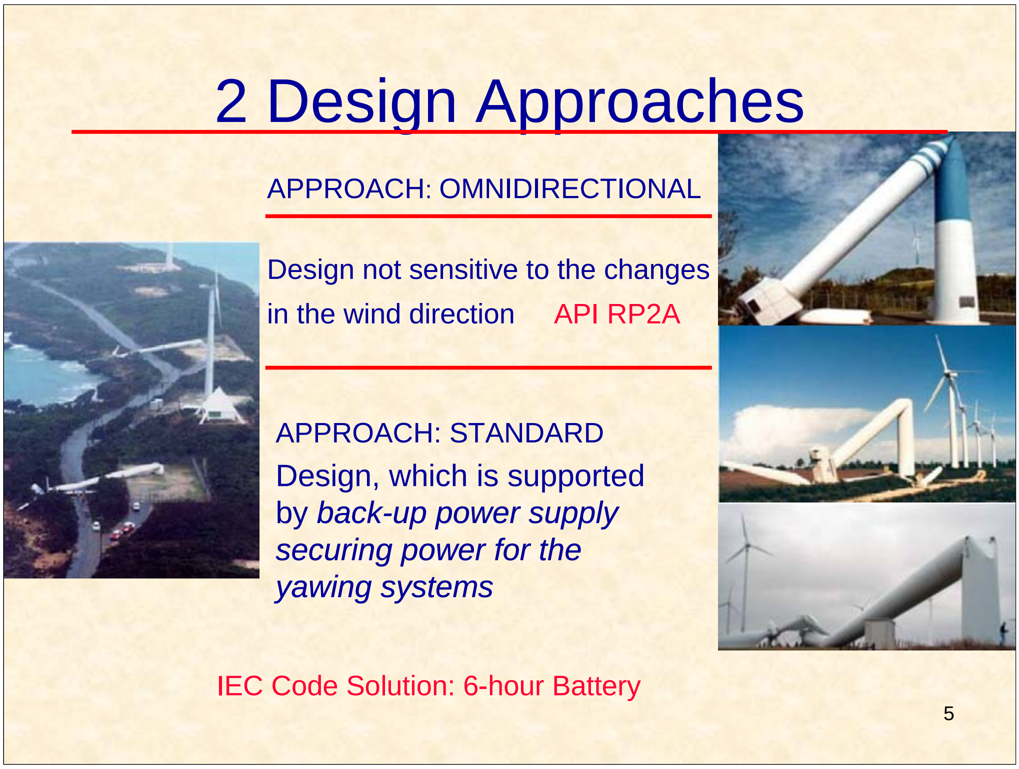
- Geographically Concentrated Risk

- Structural Integrity depends on
  - Tower Strength
  - Battery Backup for Yaw Alignment
  - Control Systems
  - Communications
  - Software
  - Fatigue Resistance of Soil
  - Very little redundancy

4

The first thing to stress is that the CVA process is not like oil and gas CVA process. Oil and Gas platforms are relatively well spaced in the Gulf of Mexico. For structures in a wind farm it is a geographically concentrated risk. All the eggs in one basket. Worse yet, since the likely location of wind farms is where there is a concentration of population, up the east coast of the US, with hurricanes that often track up the east coast it is likely that multiple wind farms are likely to be affected by one hurricane event.

Another characteristic of the offshore wind farms, according to the loading cases in the IEC Code, the structural integrity depends upon the turbine's ability to rotate into the wind within a few degrees, or the tower strength may be compromised. In the IEC Code, appropriate for Europe, the nacelle can yaw with the help of a 6 hr battery to operate the yaw system, and that appears sufficient for their purposes. For US application in hurricane areas, there are frequent wind direction shifts during hurricanes, and it is unlikely that a 6 hr battery life will be sufficient to sustain the power to orient the nacelle into the wind during the entire event. The consequences are that the tower is overloaded at anything beyond the design value of a 1-year return period storm (according to the IEC Code load cases). The probability of multiple tower failures is thus of concern. Since Structural Integrity depends on power it means the CVA process may need to check not only Tower Strength but also: the Battery Backup system; the Yaw assembly; the Control systems that return the blades to a parked position; the Software that operates the Control System; the communications that relay signals between the control computers and the mechanical mechanisms, as well as just what might be called the strictly "structural calculations" which would be the only concern with a typical oil and gas platform. The safety factors on the fatigue resistance of the soil may play an important role here as well. In short there is little or no redundancy in the offshore wind farm structures – meaning every component could be a contributor to structural failure.



The photo on the top right was from an incident in 1999 in Japan. The reference indicates that there was loss of yaw angle and then loss of the structure.

The photo on the left is from 2003 Typhoon Maemi where 7 turbine structures were lost: 3 of which were towers. Loss of power pre-ceded the failures. Admittedly the wind speeds were past the values to which the structures were designed.

In Japan - 2005 for 100 cases (out of 900 reporting) - 38 were attributed to storm and lighting; 25 to faults in construction and manufacture; 4 poor management; 33 unknown.

The other structural failures (bottom 2 photos on the right) were failures in Europe, and there is no reference in the literature as to direct cause.

There are 2 approaches that engineers could take to design of offshore wind structures. One would be to design for an omni-directional approach of the wind with the turbine in parked position or even not in parked position. In that case the role of the CVA would be easy: they would follow API RP2A. Only the Working Stress Design (WSD) version of this is incorporated in the regulations at the moment. The LRFD version could be updated and included or the ISO effort ongoing for fixed platforms could be used.

The standard approach appears to be to design using the IEC loadcases which stipulates that the design is supported by a backup power supply securing power for the yaw systems. The IEC recommended duration of the event provided for is 6 hours which may not be adequate for USA application particularly in hurricane areas.

Experience from India!

Tropical Cyclone 03/A destroyed

129 or 40% of the 315

wind turbines

A critical factor in the failures in India is that the grid also failed…….. Wind turbine manufacturers would be well advised to check that this load case has been included in their design calculations.

(prior to IEC Code)

The experience from India – probably typical of the concern for the US hurricane events is the potential loss of multiple towers in multiple fields. In India in 1998 40% of the wind turbines were lost in 1 cyclone event. A paper chronicling the event referred to the issue of loss of power being a “critical factor”. While this was over 12 years ago, the load cases that are noted in the IEC code have not sufficiently addressed this risk. Papers by Tarp Johannsen at the Offshore Technology Conference and elsewhere refer to the need for higher load factors in typhoon and hurricane areas.

Mission of BOEMRE

"Encourage orderly, safe and environmentally responsible development"

- When is that fulfilled?
  - Blade falls off? Gearbox fails?
  - Many towers fail in one field?
  - Floating wind farms break moorings and "helter-skelter"?
  - Tsunami comes up Cook Inlet (if built)?

Barometer: Somewhere in between Maintenance & the Press?

7

The Mission of the BOEMRE is noted. Our discussions will focus on when that mission is fulfilled. If the Gearbox fails, or a blade is damaged for falls off: is that considered a failure of the CVA process. That is probably more of a maintenance issue – if a ship's gearbox fails, is that a catastrophic event in the eyes of the regulator or those judging the effectiveness of the regulator? In this forum it is perhaps useful to contemplate the worst possible events and seek to put efforts and resources of the CVA process to prevent those cases: perhaps something that falls between a maintenance item and something that would attract the press to report the event as a casualty. We are after all looking at this as a social risk, not one involving the usual loss of life risk, or pollution risk. Such events may be many towers failing in one field, or floating wind farm structures breaking their moorings and drifting onto the beach possibly damaging other structures on the way. Perhaps if these offshore wind towers appear in Cook Inlet it should ensure that the design has taken account of the possibility of extra high tidal fluctuations and the possibility of Tsunamis.

CFR Guidance to Design CVA

285.707

- Independent Assessment of Design
  - Not about the Safety Management system
- CVA must certify in the Facility Design Report: that it withstands "**the environmental and functional loads appropriate for the intended service life"**

- Planning Criteria
- Operational Req'ts
- Environmental Loads
- Load Determinations
- Stress analysis
- Material Designations

IEC Covers Load NOT Resistance

- Soil and Foundations
- Safety Factors

and

Ensure USCG conditions are met for Floating Systems:

- Stability
- Foundations/ Anchorings (285.701)

8

This slide reflects the provisions for the task of the CVA as outlined in 30 CFR 285.707. It may prove difficult for commercial organizations that are likely to act as CVAs to be able to certify for the intended service life. The certification in oil and gas is a one-time event prior to startup. Certifying for a lifetime may be a potential liability that certifiers are unlikely to wish to take on. The oil and gas equivalent CVA requirement is to "ensure" rather than "certify" the structure withstands the loads for the intended service life (30 CFR 250.916. It is recommended that this wording be discussed in detail.

CFR Guidance to Fab./Install CVA

285.708

- Independently Assess Fab. /Install activities
- “Monitor” to ensure fabricated & installed per Facility Design Report
- Modifications approved by CVA/BOEMRE
- Periodic on-site inspections
- Identify all “records” on fab. /install
    - QA Records
    - As-Built Dwgs ?
    - Material Certs
    - Management of Change ?
    - Risk Register?
    - As-built of in-field and shore cables?
    - Pile blows if piled ?
    - Welding and NDT records?
    - etc.

9

The guidance offered in 30 CFR 285.708 is very similar to the requirements in oil and gas. The issue for windfarms is that the industry deals with multiple critical components whereas for oil and gas platforms the issue is much simpler. The component sources for oil and gas are usually 1 or 2 since only the steel structure needs checking and these are assembled on shore in 1 or 2 locations, whereas for wind turbines components arrive from multiple sources around the world and the majority can individually trigger a structural failure. It is suggested that to the extent possible the CVA process should rely upon Type Certification according to the IEC code, and that the CVA process commence only at the Marshalling yard (shore base prior to components being transported to the installation site).

CFR: Fabrication CVA to Verify

285.709

- Quality control by lessee
- Fabrication Site facilities
- Material Quality and identification
- Fabrication Procedures
- Welder & Welding Qual. and Identification
- Prescribed Tolerances
- NDT; Testing to destruction e.g. grout
- Repair procedures
- Splash Zone protection; corrosion- protection system
- Erection to ensure no overstressing
- Alignment
- Dimensional Check
- Mooring equipment check

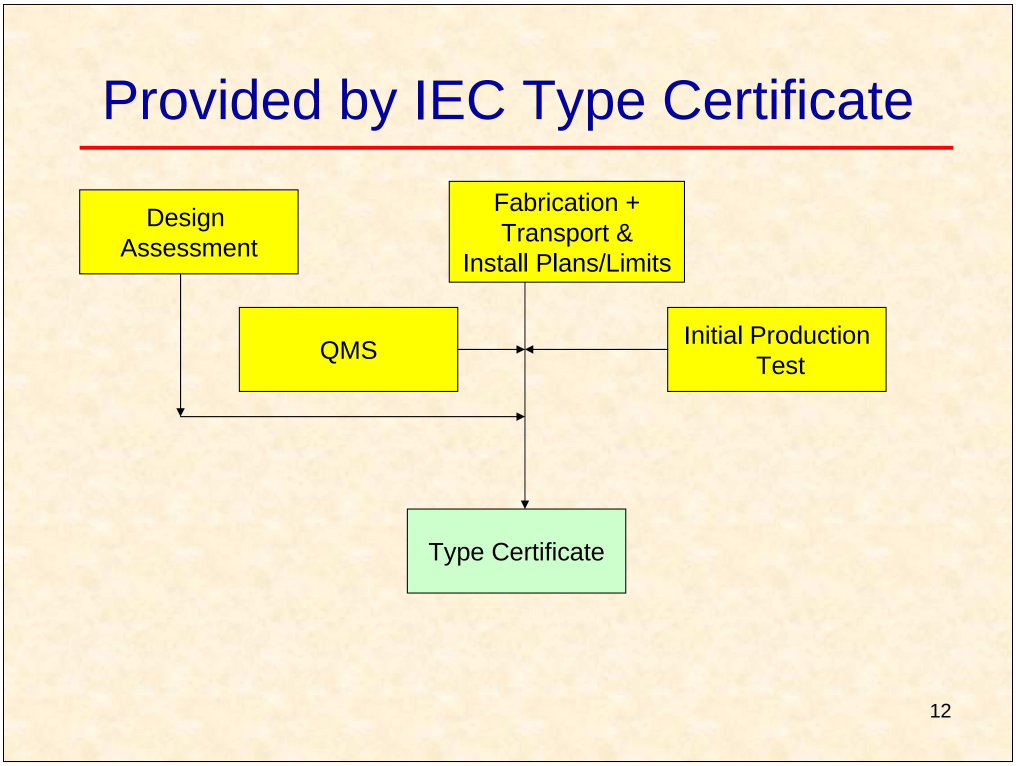
The slide lists the details reported as required by 30 CFR 285.709.

CFR: Installation CVA to Verify

285.710

- Loadout and floatation ? – need discussion
- Towing ops. procedures and review tow records – need discussion
- Pile & anchor installation
- Installation of mooring and tethering – interpreted as permanent moored equipment only
- Final deck and Component installation
- Installation at approved location
- Spot check equipment procedures, and recordkeeping to determine compliance with the applicable documents incorporated by reference and regulations.

The slide lists the details reported as required by 30 CFR 285.710.



Relying upon Type Certification as described in the IEC Code would form a good basis for the CVA process. The Type Certificate is issued by an accredited agency. In the US the accreditation agency would be ANSI and at this point in time ANSI have no program to accredit bodies in offshore wind farms as is done in Europe. Barring that, it would fall on BOEMRE to approve the Certifier as it is unlikely that the CVA would wish to take on the responsibility of ensuring that the certifier is qualified. One easy solution for the time being would be to accept a European accreditation agency qualified certifier.

Type Cert from IEC 61400-22

– 84 – 61400-22/DTS © IEC

Annex B
(informative)

Certificate Example Format

Type Certificate Example Format

TC – (Number)
Type Certificate

This certificate is issued to

XXXX
Street
City
Country

for the wind turbine

XXXX

The certificate attests compliance with IEC 61400-1 class xx (or IEC 61400-2), concerning the design and manufacture. It is based on the following reference documents:

DE-(Number)	:	Design Evaluation Conformity Statement
dated	:	dd.mm.yy
TT-(Number)	:	Type Test Conformity Statement
dated	:	dd.mm.yy
MC-(Number)	:	Manufacturing Conformity Statement
dated	:	dd.mm.yy
FDE-(Number)	:	Foundation Design Eval. Conformity Statement
dated	:	dd.mm.yy
TC-(Number)	:	Type Characteristics Conformity Statement
dated	:	dd.mm.yy
ER-(Number)	:	Final Evaluation Report
dated	:	dd.mm.yy

The conformity evaluation was carried out according to IEC/TS 61400-22 – Conformity Testing and Certification of Wind Turbines.

The wind turbine type is specified on page 2 of this certificate.

Changes in the system design or the manufacturer's quality system are to be approved by (Certification Body). Without approval the Certificate loses its validity.

This Type Certificate is valid until: dd.mm.yy.

(Location), dd.mm.yy.

ss/ss

(Certification Body)

Signature(s)

Details included in the IEC Certificate are described in Annex B to IEC 61400-22 on Certification. There may be items that need adding to this document such as life of the battery, rates of deceleration imposed by the brakes and breaking system and perhaps other points to be discussed in detail.

Commissioning for CVA req'ts

- Functioning of Emergency Shutdown Equipment
- Fail safe of Protection System incl. Triggering of Brakes by every (req'd) Operating Condition
- Functioning of Yaw System
- Behavior at loss of Load
- Functioning of Automatic operation
- Check Logic of Control System
- Check logic of Condition Monitoring
- Ensure documentation available as req'd.

While commissioning is not discussed in detail in the CFRs this slide suggests some issues to be addressed for some of the systems that ensure structural integrity under extreme circumstances.

CVA Modifications/ Decommissioing

- Out there – but our Primary Focus Today

While there is provision for the CVA to attend major modifications and decommissioning, our main focus of the workshop is the Surveillance and Design activites of the CVA.

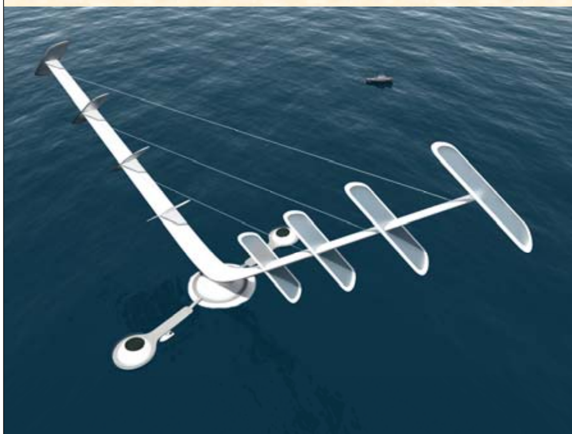
Turbine Classes for Select US Locations

IEC Wind Turbine Class	I	II	III
V_{ref} (mph) at Hub Height	111	95	84
V_{ref} (mph) at 10 m (ρ=0.08)	94	80	71
V_{ref} (mph) at 10 m (ρ=0.14)	83	71	63

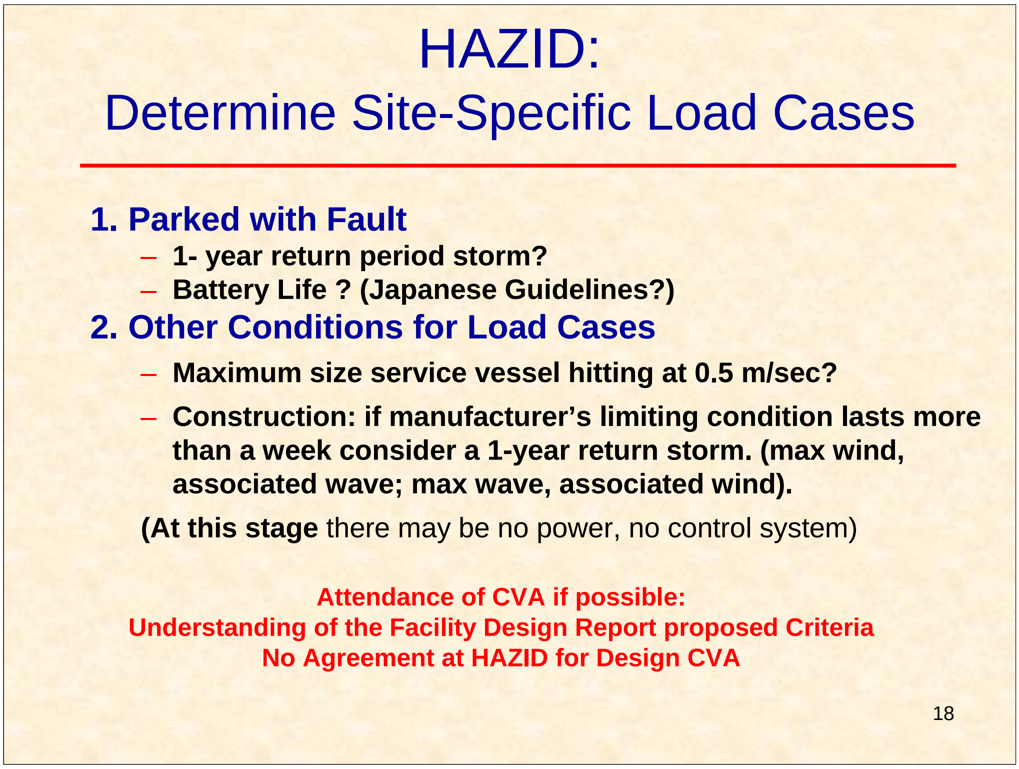
	*10-minute Average Extreme Wind Speed @ 80 m [mph] using 0.08 power law**		
	50 year	50 year	100 year
	ASCE 7	Hurricane Return Data	
Bar Harbor, ME	91	96	113
Portland, ME	91	94	104
Boston, MA	100	110	133
Hyanis, MA	105	118	138
Nantucket, MA	105	133	154
Providence, RI	100	128	150
Montauk, NY	114	117	137
New York City, NY	100	118	138
Ocean City, NJ	105	109	132
Cape May, NJ	100	94	107
Ocean City, MD	109	103	125
Virginia Beach, VA	105	113	131
Cape Hatteras, NC	118	152	165
Jacksonville, NC	118	137	154
Wilmington, NC	127	131	150
Myrtle Beach, SC	123	139	158
Charleston, SC	118	129	148
Savannah, GA	118	115	132
Jacksonville, FL	118	125	146
Daytona, FL	118	135	154
Melbourne, FL	118	150	170
Port Saint Lucie, FL	127	163	150+
West Palm Beach, FL	132	174	150+
Miami, FL	136	150+	150+
Marathon, FL	177	150+	150+
Key West, FL	177	150+	150+
Naples, FL	127	162	150+
Sarasota, FL	109	145	161
Tampa, FL	100	152	169
Cedar Key, FL	114	130	149
Tallahassee, FL	100	116	136
Apalachicola, FL	118	142	156
Panama City, FL	114	145	162
Pensacola, FL	127	150	175
Gulf Shores, AL	136	148	167
Mobile, AL	118	143	164
Gulfport, MS	127	141	161
New Orleans, LA	114	144	159
Lafeyette, LA	109	125	146
Port Arthur, TX	114	142	159
Galveston, TX	118	149	165
Port O'Conner, TX	118	141	158
Corpus Christi, TX	118	133	157
Brownsville, TX	118	130	154

At the AWEA conference just held in Atlantic City. Susan Stewart of Penn State presented an interesting table showing the IEC Wind classes that would qualify for use offshore various ports in the US, color coded for acceptability. There are many locations that the wind speed is higher than the IEC standard wind turbine classes and thus Special "S" class turbines will be required.

Adaptable for New Concepts



The CVA recommended practices must also be able to cover new and novel concepts such as floating offshore wind farms.



One of the recommendations is that there be a HAZID reported within the Facility Design Report and that the nominated CVA also be present at this HAZID. This is to ensure all the stakeholders are on the same page as far as the loadings and the implications of the loadings. For example: deciding whether the Facility Design Report will include a limitation of a 1-year return period storm if the power fails. In Japan they have been concerned about typhoons and have elected to extend the battery life depending on the results of a Monte Carlo simulation. The results of the new Japanese requirements are not yet published.

Deciding on the likely size of service vessel to design for should also be subject to an agreement between the stakeholders. It is also suggested that the criteria for temporary conditions during installation be decided at this stage. For oil and gas platform work, it is generally recognized that a 10-year storm is used for temporary conditions during assembly and installation (this is, of course, usually further offshore than for wind farms). The IEC Code recommends the temporary design condition be a 1-year storm. This is a disconnect that should be considered by the stakeholders prior to submission to BOEMRE as part of the Facility Design Report.

Work Sessions: 2

- For Each Component in the Wind Turbine
  - What to do (Surveillance/ Calculations) for CVA for 3 stages:
    - Fabrication
    - Transportation/ Loadout/ Lifting (>marshalling yd)
    - Installation
    - Commissioning
- For Each Potential Loading Event
  - What checks to be carried out by CVA

Following the introductory talks we will have 2 work sessions to decide on Surveillance and Design checks to be carried out by the CVA.

PARKING LOT ITEMS

- Whether Mechanical/Electrical Systems are included in CVA Activities
- Accreditation of Type Certifiers
- Criteria – Extremes for Tow/Installation
- - Extremes for Design
- ?

The Parking Lot Items will be accumulated in the workshop and discussed later. In order not to be diverted from our tasks we would ask the participants to accept, for the time being that mechanical and electical systems are included in the intent of the CVA process. The reason for putting this in the parking lot, is primarily because participants who are not as familiar with the workings of wind farm turbine structures have occupied a lot of time becoming educated on these points at the expense of other meetings' time. Thus, we are proposing to put this in the parking lot. It can be discussed at length in the wrap up session, and for those who wish to discuss before my collegues and I will be available to discuss it during the breaks, lunch, and the Thursday evening. It is a legitimate point, but there is more to be accomplished than just the discussion of this one point.

Another parking lot item we propose to discuss tomorrow is the accreditation issue of Type Certifiers that will be a long discussion.

The return period for extremes of design (50 vs 100 year), and extremes for temporary conditions – will be another item to discuss in parking lot session later on.

Surveillance Activities

Option 1 - Fabrication Check: (Type Cert.-accredited org.)	Option 2 - Fabrication Check: (No Type Cert.)	Loadout/Transportation & Lifting Check:	Installation Check:	Commissioning Check:
- Ensure per Facility Design Report -Type Certification for specific mfct location (Check Certification paperwork to ensure no exclusions in certs)	- Ensure per Facility Design Report. - Certified welder; Certified materials; Quality, Traceability, Weld Specs.; - Review of records, NDT and FAT as applicable (Check visually 10% - 15%: ramp % up or down with experience) - Repair per Spec.	- Ensure sign-off by Fabrication CVA - Attend first loadout/transport at marshalling area & offshore lift (10% - 15% thereafter) Visual 10% -15% at marshalling area prior to & during offshore loadout. - Conduct first batch site arrival survey & lift arrangement; (Ramp % up or down with experience) - Inspect before installation. (Verify mfct. lifting arrangements match the site situation)	- Final fitup and dimensional control (mainly tower and transitional pieces) checks; - Attend/witness first Installation and subsequently 10-15%; ramping up or down as appropriate (Welding Connection: 10% - 15% Visual inspection; ramp % up or down with experience) (Bolting Connection - see below) - Review of NDT records. - Ensure no damages or repaired to spec. - Ensure Records are kept (e.g. pile driving, bolt torque, grouting records etc.)	Attend first and then 10% of Commissioning tests or as per discretion of CVA.

Finally. During the Work Sessions – the surveillance activities have been boxed into 2 categories for the Fabrication Check, 1 for Loadout/ Transportation/ Lifting, 1 for Installation and 1 for Commissioning. We have suggested these as a starting point. As we go through each component and test what this groups thinks is appropriate activity for the CVA these activities will be expanded, changed, the % surveillance changed etc. We just have put these up as a starting point.

CVA for Design Activities

#	Items of Design Information	Proposed CVA Activity	Comments
1	**Site Specific Metocean /Seismic** etc. (wind, wave, current, waterlevel etc.) per NOAA or other standard equivalent if a TRS site; 50/100 year winter storm data; 100-year airgap.	Verify Plausibility including: Extremes, Scatter Diagrams, Breaking Waves, Temperatures, Marine Growth,etc.	
2	Site Specific Soil Data	Verify Plausibility and extent/quality of soil information; precautions e.g. Scour	
2	**Penetration** of Foundation	Verify Plausibility.	
2	**Shallow Hazard Survey**	Consider effect (if any) on design	
2	**Soil** data to determine Anchor Suitability	Verify plausibility of anchor embedment/ capability for stationkeeping based on loads and soil type.	

Finally. During the Work Sessions – the surveillance activities have been boxed into 2 categories for the Fabrication Check, 1 for Loadout/ Transportation/ Lifting, 1 for Installation and 1 for Commissioning. We have suggested these as a starting point. As we go through each component and test what this groups thinks is appropriate activity for the CVA these activities will be expanded, changed, the % surveillance changed etc. We just have put these up as a starting point.


Questions?
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APPENDIX D: Offshore Wind Energy Workshop, New Orleans

by C. Todd Wynn , Head of Offshore Wind, North America, GL Garrad Hassan

Germanischer Lloyd

Offshore Wind Energy Workshop, New Orleans

C. Todd Wynn , Head of Offshore Wind, North America, GL Garrad Hassan

Germanischer Lloyd

Content:

1. Who is Germanischer Lloyd (Renewables)

1. Germanischer Lloyd is a world-class technical service provider for the Maritime and Energy markets

Germanischer Lloyd at a glance

- Long established, privately owned and profitable technical service provider
  - 7,000 employees
  - 235 offices
  - 80 countries
- Maritime Services
  - leading ship classification society to ensure the safety of life and property at sea
  - technical consultancy for shipping and ship-building industries
- Industrial Services
  - technical assurance and
  - engineering consulting for energy and process industries

1. GL's History in Wind Energy

- 1977 First activities in Wind Energy
- 1980 Examination GROWIAN (3 MW; Ø=100m)
- 1984 Testfield Kaiser-Wilhelm-Koog
- 1986 1st Guideline (onshore)
- 1994 European Offshore Study
- 1995 1st Offshore Wind Guideline
- 2005 2nd Ed. Offshore Wind Guideline
- 2009 first german Offshore Wind Farm certified (alpha ventus)

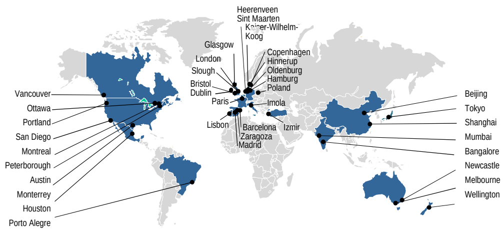
1. Who is GL Garrad Hassan

Welcome to the world's largest provider of technical advice and engineering consultancy services to the renewable energy market.

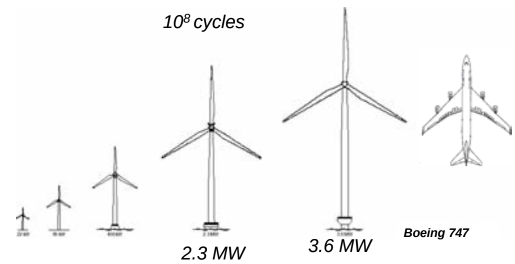
GL OPERATING 24/7 | GARRAD HASSAN | NOBLE DENTON | WINDTEST | helimax

1. Geographical reach

700 renewables staff, in 35 locations, across 22 countries



Already the world's biggest rotating machines



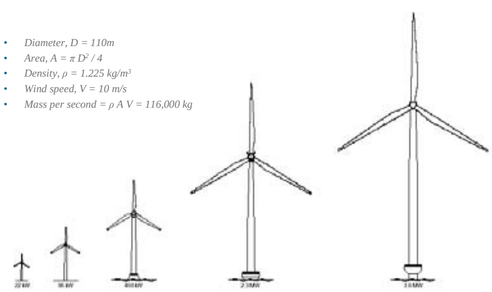
Lifetime

- A car operates continuously for about 9 months
- A wind turbine operates continuously for 20 years

One wind turbine life time = 25 VW Golf life times

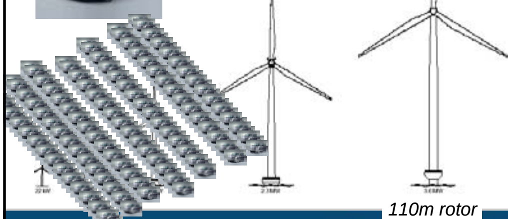
How much air passes through a rotor in one second?

- *Diameter, D = 110m*
- *Area, A = $\pi D^2 / 4$*
- *Density, ρ = 1.225 kg/m³*
- *Wind speed, V = 10 m/s*
- *Mass per second = ρ A V = 116,000 kg*



How much air passes through a rotor in one second?

100 Golfs per sec



The largest blade, 61.5m, 5MW

LM 61.5 P

Product specifications

Blade type	LM 61.5 P
Rotor diameter (max.)	126.3 m
Blade regulation	Pitch
Length	61.5 m
Max. chord	4,600 m
Profiled area	183.0 m²
Weight	17,740 kg*
Number of bolts	128
Size of bolts	M36
Bolt circle diameter	3,200 mm

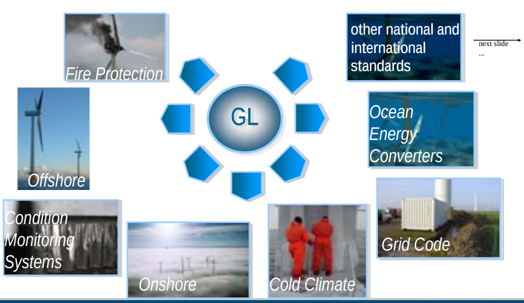
*Preliminary data

2. Rules & Guidelines, Type Certification → Project Certification

2. Certification of Wind Turbines

Certification of Windfarms, Windturbines and their components is state of the art and a must almost worldwide

2. Certification of Wind Turbines
GL-Guidelines available:



2. Further international Guidelines

Table 1: Comparison of provisions in various guidelines

	API	IEC	GL	DNV	ISO
Environmental conditions	✓				
Design load cases	✓	✓✓	✓✓	✓	✓
General guidance on offshore structural design	✓✓	✓	✓	✓	✓✓
Specific guidance on offshore wind turbine design		✓✓	✓✓	✓✓	
Ultimate limit state code checks	✓✓		✓✓	✓✓	✓✓
Fatigue limit state and serviceability limit state code checks	✓✓		✓✓	✓✓	✓✓
Project certification			✓✓	✓✓	

Key: ✓ = some guidance given ✓✓ = substantial guidance given

OTC 18984

Comparison of Design Guidelines for Offshore Wind Energy Systems

Copyright 2007, Offshore Technology Conference

2. Administrative guidelines

Process to acquire permits to erect an offshore wind farm

phase 1: development phase
(Design Basis, preliminary design for tender)

↓ 1st approval

phase 2: design phase
(site specific design)

↓ 2nd approval

phase 3: Implementation phase
(manuf. surveillance, installation, commissioning)

↓ 3rd approval

phase 4: operation phase
(maintenance and periodic monitoring)

↓

final approval for operation

2. Type Certification

Design Assessment → Implementa on of des gn requirements in Product on and Erect on **(IPE)** → **Type Certificate**

(a one time manufacturing surveillance for the main components)

Quality Management System → **Type Certificate**

Prototype Test → **Type Certificate**

2. Type Certification

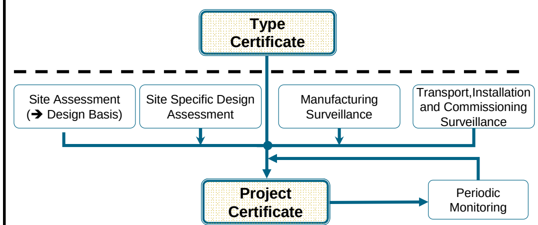
The TC of a Wind Turbine is an approval and a confirmation for an industrial serial production

➔a mass-produced article

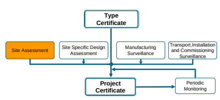
therefore, in most cases:

➔ designed with `generic loads`

2. Modules of Project Certification



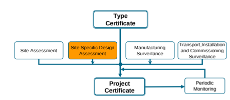
2. Modules of Project Certification
Site Assessment



- Site Assessment
  - Environmental Conditions
    wind, wave, ice data, ...
  - Soil Investigation
    soil investigation programme, soil data, soil model, p-y curves
- Further Items
  - Load Case Definitions
    combination wind - waves
  - Determination of Rules for materials, corrosion protection
  - Concept for Transport, Erection and Inspection
  - Specification of specific Analysis Methods

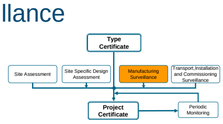
➔ leading to the Design Basis

2. Modules of Project Certification
Site Specific Design Assessment



- Load Assessment
- Assessment of the support structure
  - ULS (ultra limit state)
  - FLS (fatigue limit state)
  - investigation of details e.g. for Grouting connection, 2nd-steel
- Assessment of the turbine
  - Marinisation
  - Are site specific loads higher than those assumed in the Type Certificate? ➔ in case: reserve-calculations

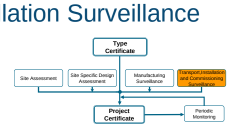
2. Modules of Project Certification
Manufacturing Surveillance



- Review of material certificates
- Inspection of NDT
- Inspection of manufacturing processes
- Inspections before delivery
- Inspection of documentation
- Inspection of tracebility of the products
- existent QM (ISO 9001:2000) is required
- Structural steelwork
- Welding
- Corrosion Protection
- Main components of the turbine
- Nacelle Assembly

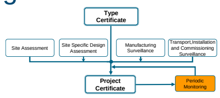
The general objective is to verify, that the production is done according to the approved drawings, rules and specifications.

2. Modules of Project Certification
Transport- and Installation Surveillance



- Monitoring of transport and installation (to and on the site)
- Monitoring of weather conditions for sea transport (Marine Warranty Survey ➔ MWS)
- Checking the components for damage
- Inspection of the offshore procedures
- Inspection of prefabricated subassemblies
- Witnessing of full commissioning

2. Modules of Project Certification
Periodic Monitoring

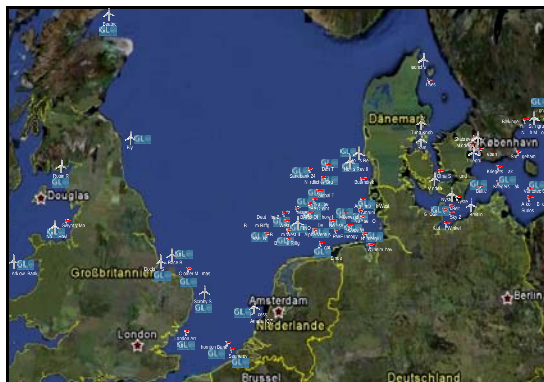


To keep the Project Certificate
valid a peridoic monitoring is required.

- Inspection of the entire wind turbine by technical experts
- Offshore: 25% of the WTGs per year.
- Electrical service station: annual inspection

2. Modules of the Project Certification

3. Reference projects

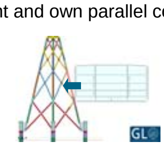


4. Example for an independent assessment (collision between ship and turbine)

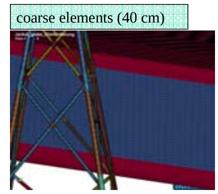
4. Independent Certification

by independent and own parallel computations:

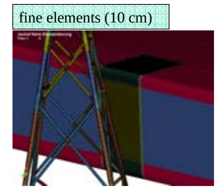
collision friendly
design ????



coarse elements (40 cm)



fine elements (10 cm)



Thank you for your attention!

go offshore
with:

GL

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APPENDIX E: Facility Design Review

by Kim Mork, DNV.

BOEMRE Offshore Wind CVA Workshop

Facility Design Review

Presentation by

Kim Moerk, PhD, MSc

DOO CE Energy Americas

Kim.mork@dnv.com

MANAGING RISK DNV

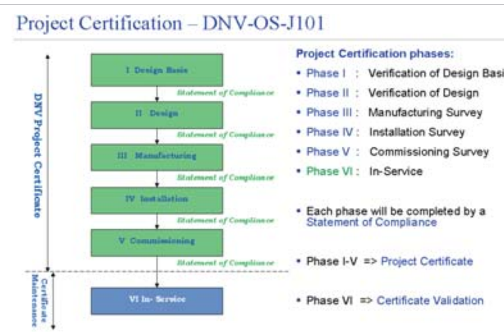
Presentation Outline

- DNV and Offshore Wind
- CVA's Primary Duties for Facility Design Review
- CVA's Primary Activities for Facility Design Review
- Accepted Design / Engineering Practices
- Discussion items for CVA's design review
- Best Practices / Systematic Approach for Design CVA
- Qualification Requirements for CVA Agency
- Concluding Remarks

DNV and Offshore Wind

- One of the largest consultancy within wind energy in USA (130+ professionals)
- Direct involvement in more than 50% of newly installed wind energy projects in USA
- Direct involvement in more than 75% of offshore wind projects worldwide
- Active participation in IEC and other international and national standards bodies
- DNV's own standards / guidelines for wind energy industry
  - DNV-OS-J101 Design of Offshore Wind Turbine Structures
  - DNV-OS-J102 Design and Manufacture of Wind Turbine Blades
  - DNV-OS-J201 Design of Offshore Substations
  - Guideline Document for Offshore Floating Wind Turbine Structures
- 2010 publications for wind energy industry
  - Guideline for Offshore Floating Wind Turbine Structures, ASME 29th, 2010
  - Qualification of a Semi-Submersible Floating Foundation for Multi-Megawatt Wind Turbines, OTC'2010
  - Several publications prior to 2010

DNV's Scheme of Project Certification



CVA's Primary Duties for Facility Design Review

<u>CRF 30 Subpart G – Facility Design, Fabrication and Installation § 285.707:</u>

- Conduct an independent assessment* of the design of the facility.
- Certify that the facility is designed to withstand the environmental and functional load conditions.
- Conduct an independent assessment* of all proposed:
  - Planning criteria;
  - Operational requirements;
  - Environmental loading data;
  - Load determinations;
  - Stress analyses;
  - Material designations;
  - Soil and foundation conditions;
  - Safety factors; and
  - Other pertinent parameters of the proposed design.

CVA's Primary Activities for Facility Design Review

<u>DNV stipulate following key design review activities to meet CFR § 285.707:</u>

- Review site-specific metocean, geotechnical and other design parameters
  - Wave and current data
  - Variation in soil properties
  - Location and method of soil investigation
  - Scour protection
- Review structural and fatigue analysis (incl. tower and foundation)
  - Loads (types of loads, load interface, load combination etc)
  - Modeling (mesh size, choice of elements etc)
  - Analysis methodology (linear, non-linear, dynamic effect etc)
  - Stress levels and safety factors
  - Critical connections (e.g. Grouted connection, bolted connection at tower base)
  - Structural integrity under temporary conditions (load out, transport, lift etc)
  - Structural integrity under hurricane, typhoon, ice, earthquake, collision (as appropriate)
  - Other pertinent design parameters
- Review material selection; ensure corrosion protection
- Issue interim and final design review reports

CVA’s Primary Activities for Facility Design Review (cont.)

DNV stipulate following additional design review activities for floating facility:

- Review of following:
  - Hull strength, scantling and fatigue analysis
  - Load transfer between hull and topsides
  - Global performance (motion) analysis
  - Ballast and stability analysis
  - Mooring analysis (permanent, disconnectable)

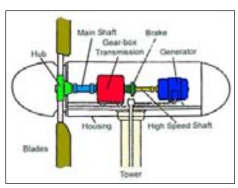
Accepted Design / Engineering Practices

- *There is no established design standard for offshore wind turbines in US waters*.
- AWEA subcommittee for Offshore Wind Turbine is adopting a *wrapper approach*. The subcommittee plan to refer to existing standards in the following order:
  - IEC 61400-3 “Wind Turbines – Design Requirements for Offshore Wind Turbines”
  - IEC 61400-1 “Wind Turbines – Design Requirements”
  - ISO 19902:2007 “Fixed steel offshore structures”
  - Other references such as AISC-LRFD (13th ed), API RP-2A (21st ed)
  - Other applicable international standards when necessary.
- The Load & Resistance Factor Design (LRFD) method will be the primary method adopted for analysis and design of structural members.
- Design conditions specific to offshore structures in U.S. waters, such as metocean criteria, hurricanes etc, are to be aligned according to current industry practice (applicable API RPs) for offshore oil and gas facilities in the U.S.

Discussion Items for CVA’s Design Review

DNV recommend to have discussion on CVA role in design review of following:

- Certification / review of vendor supplied materials and components
  - Blades design
  - Wind turbine certification (hub, gear box, main shaft, brake, generator, housing etc)
  - Transformers
  - Subsea cables (transmission line, fiber optic)
- Safety of Personnel and the Facility
  - Software for control and condition monitoring
  - Hazardous area classification*
  - Emergency shut down system*
  - Fire detection and protection system*
  - Escape and evacuation system*
  - Communication system*
  - ...and other safety systems



* For O&G facilities it is assumed to be reviewed and verified by BOEMRE / USCG

Best Practices / Systematic Approach for Design CVA

DNV recommendation to ensure minimum standard for CVA work performed under auspices of 30 CFR 285 Subpart G:

- Involvement of CVA at early phase of the project
- CVA nomination meeting
  - To ensure CVA agency is qualified
  - To ensure minimum standard for scope of work
- Review of CVA project quality plan to ensure
  - Appropriate level of CVA involvement during all phases
  - CVA quality system is adequate
  - Provision for regular interface between BOEMRE and CVA
  - Project specific checklists are developed
  - What, how, who, when, where is documented
- Provision for audit by BOEMRE
  - Technical audit to ensure execution as per proposed scope of work
- Risk based verification
  - Increased CVA involvement for safety critical items
  - Independent analysis by CVA

Qualification Requirements for CVA Agency

Below are qualification requirements for CVA Agency as stipulated in CFR § 285.706:

- Previous experience on wind and other offshore energy facilities
- Technical capability of proposed project team
- Size and type of organization and industry recognition
- R&D initiatives and investment in the related field
- In-house access to analysis software programs
- Previous experience with BOEMRE requirements and procedures
- BOEMRE prior experience with quality of work by the CVA

Concluding remarks

- Clarification of CVA role outside structural integrity and environmental protection
- Scope of work and execution methodology shall be appropriate to gain sufficient confidence
- Additional items for CVA’s design review to be discussed and agreed
- CVA shall employ best practices (Project Quality Plan, project specific checklists)
- Ensure qualification of CVA agency to ensure minimum standard
- Review / technical audit on CVA execution by BOEMRE

Safeguarding life, property
and the environment

www.dnv.com

MANAGING RISK

APPENDIX F: Bureau Veritas and Offshore Wind Farm Fabrication

by Raul Vieira.

Bureau Veritas and Offshore Wind Farm Fabrication

BOERE - Offshore Wind CVA Workshop

October 2009

BUREAU VERITAS

Move Forward with Confidence

Contents

Basic Scope of Services

Key Reference Codes and Standards

Bureau Veritas Technical Requirements for Inspection of the Wind Turbine fabrication are based on the following standards:

- IEC 61400-3: 2009 Design requirements for offshore wind turbines
- IEC WT 01: *"EC System for Conformity Testing and Certification of Wind Turbines, Rules and Procedures, 2001-04"*
- BV NI 572 (draft 2010): Classification of Floating Offshore Wind Turbines
- BV NR 445 (2010): Rules for Classification of Offshore Units
- BV NR 493 R1 (2008): Classification of Mooring Systems for Permanent Offshore Units
- BV GM 210 R1 (2010): Certification of Industrial Products
- BV GM 250 R1 (2010): Certification of Wind Turbines

Key Reference Codes and Standards

This presentation covers in addition the requirements introduced in the following legal instrument for CVA activity:

- 30 CFR Part 285 Subpart G

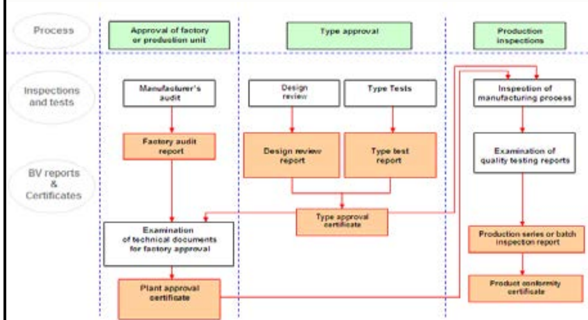
Basic Coverage of Fabrication Assessment

As a general rule, the certification of fabrication requires the assessment of the following major components:

- Mechanical Systems
- Electrical Systems
- Control and Protection Systems
- Structures, including:
  - Foundations and anchoring systems
  - Floating Platforms or Fixed Support Structures
  - Tower

Product Certification

General flow of Product Certification



Red boxes refer to mandatory "Final Evaluation reports" or "Certificates" including and detailing a clear statements of compliance

General Principles

- ► Product certification provides a way of demonstrating that products conform to specified requirements, increasing confidence in the announcement of such conformity
- ► Product certification views the consistency of manufacture of a product in relation to specific characteristics and performances stipulated in a certification reference document
- ► Certification demonstrates that a product from a given production cycle meets the criteria stipulated in a reference document (prototype) and the applicable legislation
- ► A certified product is an identified, marked product recognisable by the user, who needs to make no further check or inspection

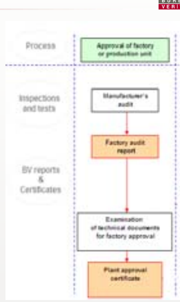
Factory Approval

Factory Approval – An Audit Approach

Based on reference document drawn up and validated jointly with the manufacturer/supplier.

Every certification reference document sets its own scope of application and details. They should cover at least:

- ➢Characteristics selected to define products for inspection, and limit values for such characteristics
- ➢Nature and form of presentation of data regarded as essential and which must be announced to users, including buyers,
- ➢Testing, measurement, analysis, inspection or assessment methods used to establish the certified characteristics
- ➢Conditions for inspections to be carried out by the certification body
- ➢Conditions of installation and servicing



Factory Approval – Execution and Outcome

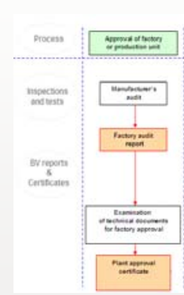
The factory approval consists of an initial assessment of the manufacturer quality system applied to the production unit

It is performed on the basis of the reference document

This assessment will determine the level of compliance of the manufacturing program with the specified reference, and **will provide indication of the level of interventions required during prototype review and production**

The assessment may, in function of the initial results, the type testing, and the manufacturing program, be followed by surveillance audits

The surveillance audits are used to maintain and renew confidence along the production life cycle



Prototype Test

Prototype Test – Inspection of Representative Specimen

To assess if a specific wind turbine type is manufactured in conformity with the Design Evaluation, detailed information is provided for the components to be considered for inspection:

- ➢Rotor blades, Rotor hub, Rotor shaft
- ➢Main pitch and yaw bearings (pitch and yaw drives)
- ➢Main bearing housings and gear box
- ➢Locking devices and mechanical brake
- ➢Generator, transformer with associated main frames
- ➢Tower, support and foundation
- ➢Bolted connections and hub and nacelle assembly (in workshop)

Inspections will ensure critical components and critical manufacturing processes are observed and implemented in production and assembly.

Prototype Test – Certification Tests

Type tests provide data needed to verify aspects which are vital to safety and therefore need additional experimental verification, and aspects which cannot be reliably evaluated by analysis.

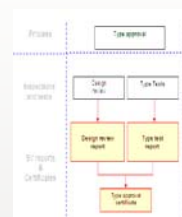
The type test comprises the elements given below:

- ➢Safety & Function Tests
- ➢Dynamic Behaviour Tests
- ➢Load Measurements
- ➢Blade Tests
- ➢Other Component tests

Extent of testing shall be defined by the applicant subject to approval on a case by case basis

Prototype Test – Certification Tests

Testing of these aspects is carried out on a representative turbine of the type to be certified



Inspection records need to be completed prior to the tests in order to demonstrate satisfactory conformity to the turbine with design documentation.

Certification tests are carried out by a test laboratory and documented in tests reports

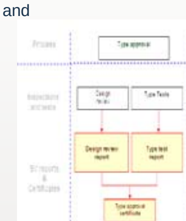
Blade structural tests are required for Certification. Two tests are recommended:

- ➢Ultimate-load test simulating extreme wind loading and indicating the blade's strength safety margin over the worst winds specified for the turbine design class.
- ➢Fatigue test applying cyclic bending loads to the blade. The fatigue test simulates repetitive high-wind conditions that the turbine might undergo a 20 to 30 year exposure to the environment.

Prototype Test – Type Characteristic Measurements

Type characteristic measurements establish performance related characteristics of the wind turbine type

These optional tests may be selected by the applicant and shall conform to relevant IEC 61400 standards



They comprise the following elements:

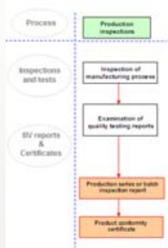
- ➢Power performance tests
- ➢Acoustic noise measurements

Production Inspection

Production Inspection – Basic Rules

Inspection conditions depend on what guarantees the manufacturer can offer regarding control of his production process, particularly by applying a quality assurance system

- ➢If no quality assurance system is applied, in general inspection of equipment consists of statistical inspection by attributes
- ➢If the manufacturer can assure the necessary steps to control the manufacturing process, the inspection is carried out using a simple randomly-timed sampling plan

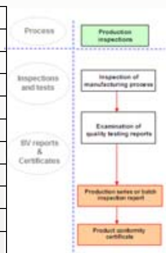


Production Inspection – Tower Structure Scenario

Production Inspection – Tower Structure Scenario

The one-off Offshore picture requires certification verification of:

Quality Control plans	Welding consumables
Construction drawings	Welding parameters
Welding procedure specifications	Visual weld random checks
Qualifications of NDT operators	Identification of NDT operators
Fabrication procedures	Non destructive testing
Testing procedures	Heat treatments
List of Subcontractors and Vendors	Dimensional inspection
Survey of fabrication of structures	Final visual examination
Materials	Site queries
Material traceability	Non conformity reports
Main fit-ups before welding	Modifications / changes
Identification of welders	Release notes
Preheating	Closing out the relevant punch-list



Production Inspection – Tower Structure Scenario

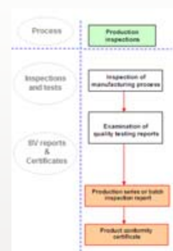
With the application of the Product Certification concept, the bulk of these activities remain the sole responsibility of the manufacturer

Many of the requirements can be dealt with through:

- ➢The surveillance audit program
- ➢A planned schedule of sampling activities
- ➢Unscheduled visits

The majority of the verifications performed during these activities will be based on verification of records

This shall not preclude the execution of inspections during the visits



Production Inspection – Tower Structure Scenario

Some activities, however, may be subject to inspections (sampling) or witnessing (hold points)

They can be activities related to specific changes during the execution of the project, such as welder or NDT personnel qualifications

They can also be determined from the results of the factory audit or the type testing

And ultimately, by specific requirements of the legislation

Questions

BUREAU
VERITAS

Move Forward with Confidence

APPENDIX G: ABS Thoughts on CVA Process for Offshore Wind Farm Surveillance, Transportation, & Installation

by Luiz Feijo.

Offshore Wind CVA Workshop

New Orleans
21-22 Oct 2010

ABS Thoughts on CVA Process for Offshore Wind Farm Surveillance Transportation, & Installation

Luiz Feijo
ABS

Agenda

- Overview of 30 CFR 285 requirements
- Possible overlaps with IEC 61400-22
- Challenges of Transportation and Installation Process
- ABS Proposal to Optimize the CVA scope
- Conclusion

Overview of 30 CFR 285.708

CVA Duties for Installation Phase

- CVA to conduct periodic onsite inspections
  - While installation is in progress
  - Verify, witness, survey or check
  - Spot check equipment/procedure/recordkeeping as necessary
- Certify that components are installed:
  - Good engineering practices
  - Approved plan
  - Installation Report
- If not, CVA informs developer
  - Developer informs BOEMRE if modifications are accepted

What is ABS?

- **Founded in 1862**
- **'Not-For-Profit' Marine Classification Society**
- **No owners/shareholders**
- **Focusing in promoting the security of life, property and the natural environment**

Overview of 30 CFR 285.710

- Transportation
  - Loadout
    - Jackets/decks/piles/structures
    - From each fabrication site
  - Initial Flotation
  - Towing and towing records
  - On-site inspection after transportation

Overview of 30 CFR 285.710

- Installation
  - Launching/uprighting/submergence
  - Piles/anchoring/templates
  - Mooring/tethering systems
  - Deck and "component" installation
  - "Actual" installation
  - Installation to approved location per Facility Design Report and Fabrication and Installation Report

IEC 61400-22 - Certification

- Requirements for Type Certification
- Transportation
  - Turbine can be transported based on requirements in design documentation
    - Technical specification for transportation
    - Environmental conditions
    - Transportation arrangement – fixtures, tools, equipment
    - Load conditions
  - To be documented in Transportation Manual

IEC 61400-22 – Certification (cont.)

- Installation
  - To be sufficiently described to allow verification of adequacy of design
    - Resources – human, tools, fixtures and equipment
    - Interface points
    - Control check points
    - Safety
    - Commissioning procedure
  - To be documented in Installation Manual

IEC 61400-22 vs. CVA

- IEC:
  - Based on review of procedures
  - Product level
- CVA:
  - Based on physical installation
  - Facility level – including turbine?
- Possible Overlaps
  - Limited to review of transportation and installation procedures, but different approaches

Concern:

How much credit can be taken from Type Certification towards CVA

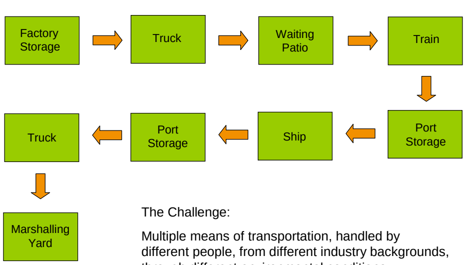
Challenges - Transportation

Final Components and Pre-Assembled Parts

- Built in different geographical locations
  - possibly by multiple manufacturers
  - multiple transportation regimes
- Large amount of inland and on-water transportation
  - different methods
  - different companies

Transportation Challenges

From Factory/Fabricator to Marshalling Yard



The Challenge:

Multiple means of transportation, handled by different people, from different industry backgrounds, through different environmental conditions

Transportation Challenges

Storage

Transportation Challenges

Lifting

Transportation Challenges

Trucking

Transportation Challenges

Shipping

Transportation Challenges

Offshore Transportation to Site

- Multiple pieces requiring multiple trips
- Different barges, installation vessels, lifting equipment, sea states, etc

Marine Warranty Surveyor is usually involved to monitor the transportation

Installation Challenges

General

- Large number of components
  - Multiple installation contractors and installation procedures
  - Simultaneous operations
  - Duration

Installation Challenges

Piles

- Location, Penetration, Orientation, Inclination
  - Very important to achieve desired performance, even more important in monopiles installation
  - Dependent upon driving procedures

Transition Pieces

- Grouting, Bolting, Welding
  - Quality control
  - procedures
  - NDE

Installation Challenges

Jackets

- Launching, uprighting, lifting
  - Variable water depth within field
  - Different weights
  - Different procedures

Floating Facilities

- Mooring, Ballasting
  - Traceability of mooring lines – variable sizes, lengths, accessories
  - Mooring tension, draft, stability – impact station keeping

ABS Proposal - Transportation

- From manufacturer/fabricator to marshalling yard:
  - Assumed to be manufacturer's responsibility
- CVA scope to cover from marshalling yard to offshore site
  - Final inspection at marshalling yard
  - Possibility of on-shore repairs
  - Visual upon receipt on site

ABS Proposal - Transportation

- Activities
  - Visual inspection at yard
  - Close visual at yard
  - Lifting, tiedown
  - Offshore receipt survey
- Witness % based on procedures, yards, vessels, criticality
- Review 100% records

ABS Proposal - Installation

Foundations (Piles, Transition Piece, Jackets)

- Witness % per installation contractor, or per installation procedure
- Review 100% installation records

Notes:

- % may be higher for monopiles than for jacket or floating structures type
- Review welding procedures/qualifications/NDE

ABS Proposal - Installation

Floating Structures

Discussion:

- Structures covered by 30 CFR 285
- Other aspects and operations directly involving structural integrity
- No requirements from USCG

Question:

Floating structures should:

- follow 30 CFR 285 for one-time installation?
- follow 46 `CFR Subchapter I-A?
- be required to be classed?

Conclusion

30 CFR 285 as it stands presents insufficient verifiable or measurable parameters for consistent CVA verification

Boundaries to be better defined and parameters to be set based on the criticality of individual component or operation.

Verification level to be better defined by sampling

Sampling to be based on industry experience and data collection on similar operations

Bottleneck items that may impact operations and structural integrity to be addressed (transformers, subsea cable to shore) www.eagle.org

APPENDIX H: Certification of the complete project: How to deal with the uncertainties and with site specific turbine certification

By Jaap Olthoff OWG BV/Ovento

"Certification of the complete project:
How to deal with the uncertainties and with site specific turbine certification"

a developers viewpoint

– Jaap Olthoff –
OWG BV/Ovento

Jaap Olthoff

- Aerospace engineer
- Windenergy since 1979
- Rotorblade design
- General management
- blade manufacturing
- turbine production
- Wind project development
- Offshore wind project development director
- Offshore wind QA manager
- General manager WE development dept utility
- Technical manager Vtfl Wind Benelux
- Founder of OWC > Ovento: Wind Project development support

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Contents

- Introduction and playing field
- The typical offshore wind project elements
- Most elements are closely interlinked
- Site specific conditions relating to the turbine
  - Design codes
- Uncertainties
  - – risk mitigation
  - QA/QC approach
- Who wants a certificate: perspective and role of:
  - Owner
  - Lender
  - Contractor
  - Governements
  - Insurance
  - Certifiing bodies
- Role of certification

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➢**Playing field**

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Offshore Wind park life cycle

Development	Financing	Construction	Operation
5 to 10 years; From green field or empty sea to all contract s and permits in place	Arrangement of Debt / Equity	1 to 2 years	Asset management and optimisation; Maintenance; Monitoring; Decommisioning

Financial Close:
GO

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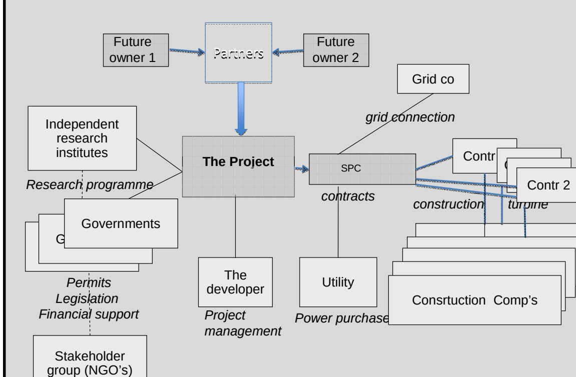

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The key player: the developer

but they are all different

- Pure project developers how saw the early light
- Well developed professional project developers
- Project developers taken over by an investor
- Investors with a project development dept
- Utilities with a project development dept

Very much depending on the type of developer the design proces is structured for:

- Lowest cost, early exit
- Safe operation
- Lowest cost of ownership
- Relaibility

➢ **Typical project breakdown, large impact on design management**

Offshore windpark Egmond aan Zee

- •36 turbines V90
- •Interarray and export cables
- •Substation
- •Substructures
- •Met tower

Complex contracting and design structure

- Major subcontractors include:
  - wind turbine supply, commissioning, operation and maintenance
  - civil design, installation, and maintenance
  - electrical design
  - fabrication of substructures
  - transportation to site
  - Substructure and wind turbine installation
  - scour protection
  - cable supply
  - Power & Umbilical: cable transport and installation
  - Offshore substation design and construction
  - Diving works
  - Environmental monitoring

A prefered project split up

The works are divided into 3 lots:

- Lot 1: Support structures + marine works
- Lot 2: Wind turbines
- Lot 3: Electrical works

Note: three lots have three interfaces > 6 lots have 15 interfaces !!

Enough interfaces to handle

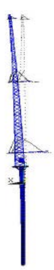
Large design method difference in the *standard* project elements and the *one off* solutions

	tested	certified	track record	applicability of lessons learnt	accpt standard
Turbines	+	+	+	++	+
Cables	+	+	-/+	+	+
Transformer	+	+	-/+	++	+
Substructures	-	+	-	-/+	-
Installation meth	-	-	-/+	-/+	-

Designs for the one off solutions are project based and optimized per project

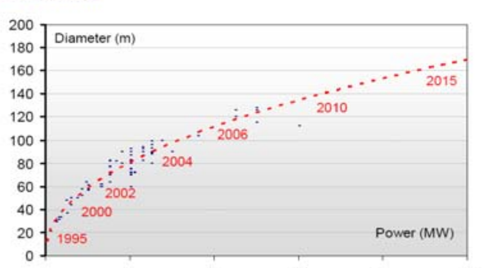
Taylored solutions

One off structures



But also turbines are still under development

Bigger is better...



What is special offshore

- Offshore site specific conditions

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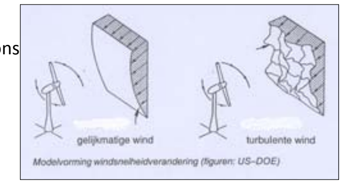
Special for offshore turbine conditions

- Interaction between foundation stiffness, turbine dynamics and wave loading
- The wind conditions



- Corrosive environment
- Crew safety
- Installation and offshore handling and loads

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Meteo Mast

Foundation: Monopile ø 2750 mm, L=55 m

Transition Piece, ø 3000 mm, 17 m high, grouted to monopile

Platform on 12+ MSL, with foghorn, fog-detection, radar reflector and solar panels

Lattice tower, 104 m above platform on 12 m + MSL to 116 m + MSL.

Meteomast

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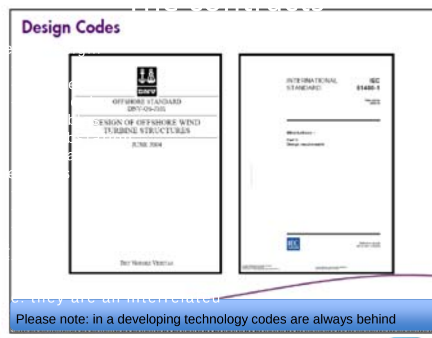
OFFSHORE WINDPARK EGMOND – HLV SVANEN – FOUNDATIONS – TURBINES – ELECTRICAL

This has been captured in standards



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Uncertainties

- risk mitigation
- QA/QC approach

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Examples of uncertainties

- Uncertainty in soilconditions , leading to:
  - Foundation stiffness variation
  - Foundation strength uncertainty
  - Scour protection defects
  - Installation problems, unsafety
  - Uncertainty about maintenance costs
- Wave characteristics
  - Working conditions
  - Design loads

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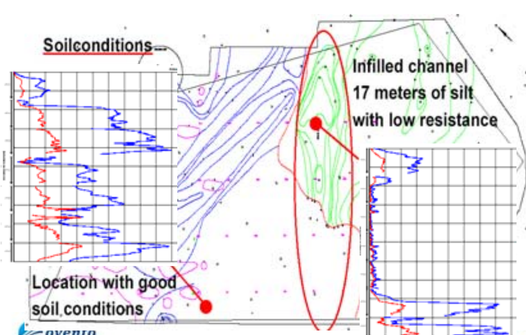

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Determination of uncertainties

uncertain now > risk later

Specialists workshops: define and rank the risks

Downstream Va ue Processes — Lessons learned ranking matrix

CONSEQUENCES						INCREASING PROBABILITY				
Severity		People	Assets	Environment	Reputation	1 Insignificant: Occurs in 1 out of 100 Projects	2 Low: 1 out of 20 Projects	3 Medium: 1 out of 10 Projects	4 High: Occurs more often than not	5 Very High: Occurs in near every Project
5	Very High	Life Threatening	Extensive damage	Massive effect	International impact	5	10	15	20	25
4	High	Serious Injury or Lost Time	Major damage	Major effect	National impact	4	8	12	16	20
3	Medium	Multiple Injuries or Illnesses	Localised damage	Localised effect	Considerable impact	3	6	9	12	15
2	Low	Minor Injury or Illness	Minor damage	Minor effect	Limited impact	2	4	6	8	10
1	Insignificant	First Aid	Slight damage	Slight effect	Slight impact	1	2	3	4	5

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QA/QC is implemented to assure the certainties

- Some QA/QC expereince
  - In general the QA/QC systems have been very well implemented in the turbine production, less well at pré assy and site assy in starting up phase
  - QA/QC systems are difficult manageble for offshore cable laying and transformer station
  - Offshore works have their own QA dynamics and are more difficult to check hands on
  - The 100% quality checks that turbine manufacturers demands prevents a lot of uncertainties

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Certification, perspective and role of:

Owner
Lender
Contractor
Governements
Insurance
Certifiing bodies

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Entity	wants a certificate or demands a certificate	reason	Pays for the certificate	Sort of certificate	Comments
Owner	Wants/demands	Third party design judgment Safeguarding the return on investment Operational safety	Indirect	Preferably full project certificate, to be checked by independent consultant	A certificate checks against a standard, when the standard is not there or the technology is unique, the certificate by nature cannot give full comfort
Project developer for ex t	No, only when legally enforced	Certificate is a cost, contractors design should give comfort	No, unless demanded by future owner	Only the bare minimum	The pure developer works for the future sales of the project before construction
Project developer for future owner	Wants and demands	Third party proof to owner that the project is safe and sound	yes	Enough to satisfy owner	See owner
Lender	Demands like an owner	See owner	Indirect	As much as possible, to be checked by independent consultant	See owner
Contractor	No, unless demanded	Contractor makes its own design calculations, certificate gives no added value	yes	As less as possible, preferably not to be checked	Contractors have their own quality checks and will follow the standards or assist to develop these

Entity	wants a certificate or demands a certificate	reason	Pays for the certificate	Sort of certificate	Comments
Lende	Demands like an owner	See owner	Indirect	As much as possible, to be checked by independent consultant	See owner
Contractor	No, unless demanded	Contractor makes its own design calculations, certificate gives no added value	yes	As less as possible, preferably not to be checked	Contractors have their own quality checks and will follow the standards or assist to develop these
Governement that prov des permits	Demands	Safe operation and avoidance of hinder	no	As wide and narrow as necessary to cover safety and hinder aspects	Permitting bodies have no real interest in the commercial operation
Governmen tha provides grants	Deamands	Performance of the works	indirect	As wide as needed to safeguard reliable operation	The granting government has a target

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Entity	wants a certificate or demands a certificate	reason	Pays for the certificate	Sort of certificate	Comments
Insurance	Demands	Third party design judgment Safeguarding the design to be fit for purpose with a minimum change of mechanical failure	no	As much as possible, to be checked by independent insurance consultant	A certificate checks against a standard, when the standard is not there or the technology is unique, the certificate by nature cannot give full comfort
Cert fying bodies	No	They are instrumental	No	Often depending on the available skills with the specific organisation	When the codes by nature are behind in up to date knowledge, the certifying bodies are one step behind the code updates

So, the guy that pays is not the most interested

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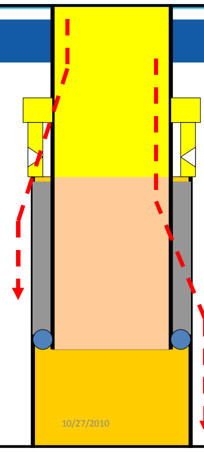
Grouting

A certificate gives no certainty when there is no proven standard



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The certificate

• Goal is to certify that the elements subject to certification have been designed according to the standards

•So standards are key

•Standards are developed and improved because of lessons learnt from practice, not from theory

•The present turbine standards are based upon 30 years of practical experience

•The next step has to be a total project design standard

•Certification of the separate project elements can be restricted to the project specific and site specific items

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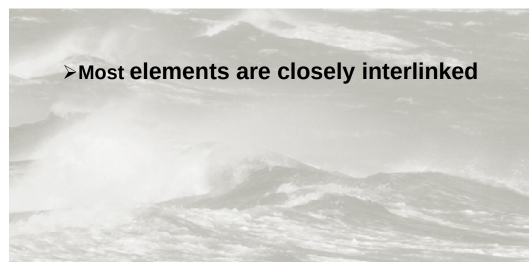

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Example of interdependency: the export cable

• the cable short cut load is an important design parameter for
 blades
 drive train
 yaw mechanism
 turbine power electronics
 main transformer

• the safety algorithms, to prevent damage due to short cut, are tailored to the actual response of the electric system during this event

• the design of the export cables is key the response characteristic of the system

•So: now the blade tip of the turbine most far out, has an interdependency with the cable where it is connected to the grid!

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Role of the Government

•Take care of certainty and clearity in procedures
•Take care of procedures that fit with the industry practice
•Take care of procedures that fit within practical timelines
•Take care of procedures that fit with the needed flexibility

•Example:

•A development period might take 10 years
•During that period the turbine choice will definitively change
•It is useless to judge the acceptance of the first permit application on the foundation calculations

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Some conclusions

- In an offshore wind project the elements are closely interlinked
- This means that a partial certificate has no meaning for the project as a whole
- Therefore the project design as a whole has to be certified
- Certification has a value only when there are proven standards
- There were existing standards apply the partial certificate is a plug in
- Certification should be a flexible process

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APPENDIX I: Recap of the O&G CVA Process

by Partha Ganguly, Millennium Technical Consultants Inc.

BOEMRE Offshore Wind Energy Workshop
Recap of the O&G CVA Process

Partha Ganguly, P.E.

Millennium Technical Consultants, Inc.
Houston

MTC, Inc

BOEMRE
OFFSHORE WIND CVA WORKSHOP

Brief Overview

- The Current Offshore Oil & Gas CVA Process
- High Level Comparison to the Wind Energy CVA Process

MTC, Inc

Offshore Wind CVA Workshop – The CVA Process

The Current Offshore O & G CVA Process

- Addressed in 30 CFR Subpart I
- Addresses "Structural Integrity" for Drilling, Production and Workover Operations
- Approval and Verification Programs
  - Platform Approval Program (PAP): Proven Designs in WD ≤ 400 Ft, f ≤ 3 sec and located in stable areas. (Note: Platforms with unproven design or designs which have not been used before will need a PVP – see below)
  - Platform Verification Program (PVP) WD > 400 Ft, f>3sec or located in unstable areas and Floating Platforms.
  - The PVP calls for the need of an independent 3rd party structural verification – the CVA process

MTC, Inc

Offshore Wind CVA Workshop – The CVA Process

Background of the Current CVA Process for the O & G Application

- Introduction of the PAP / PVP Processes evolved as the industry ventured into plays in deeper waters. PAP addressed shallower water structures, with lower natural frequency. It also accepted proven types of design.
- PVP addressed deeper water structures with higher natural frequencies etc.
- PAP and PVP address <u>only</u> structural integrity
- For Oil and Gas Facilities, non-structural issues are, addressed outside the CVA requirements, e.g.:
  - BOP Inspection & Maintenance – 30 CFR 250 Subpart D
  - Production Safety System – 30 CFR 250 Subpart H
  - Pipeline Inspection – 30 CFR 250 Subpart J

MTC, Inc

Offshore Wind CVA Workshop – The CVA Process

Background of the Current CVA Process for the O & G Application (contd)

<u>Similarities of Overall Rulemaking Approach</u>:

- Apart from the CVA stipulations for wind energy structures, the requirements for Site Assessment Plan (§285.605), Construction and Operation Plan (§285.620) and the General Activities Plan (§285.640) <u>simulate</u> the requirements for the submission of the Exploration Plan (EP), Development Operations Coordination Document (DOCD), the Deep Water Operations Plan (DWOP) and the Platform Approval Program that apply to the Offshore O & G Facilities
- O & G Application require the CVA to address primarily Structural & Foundation elements (with the exception of Cables in Wind Energy structures – Ref Facility Design Report - §285.701)
- Question: Did the Wind Energy regulations miss addressing structural integrity aspects caused by non- structural faults?

MTC, Inc

Offshore Wind Energy Workshop – The CVA Process

The Three Phases of O & G CVA Activities

- Design
- Fabrication
- Installation

<u>Similarities with the Wind Energy</u>

In general the same overview, witnessing, verification requirements for all three phases of activities.

<u>Differences</u>

In the O & G regulations the CVA is required to <u>ensure</u> appropriateness of design and fabrication.

In wind energy structures the CVA is required to <u>certify</u> the above.

MTC, Inc

APPENDIX J: CVA WORKSHEET LOADOUT/ TRANSPORTATION / INSTALLATION & COMMISSIONING

Presented by Kent Dangtran, DOTC

1	Rotor Components	
1.1	Hub	Hub serves as a base for the rotor blade and extenders Houses the control system for the pitch drive. Rotates freely and attaches to nacelle via a shaft and bearing assembly
1.2	Extenders	Spool piece to secure blades into hub
1.3	Rotor Blades	Means to convert wind energy to mechanical energy. Variable-pitch blades min their surface area thus regulate rotational speed. Regulate rotational momentum in high wind condition to avoid damaging turbine.
1.4	Blade Bolting	Mechanical connection for blades to extenders and extenders to hub
1.5	Blade Coating	Coating applied to the blades to minimize wear and protect leading edge of the blades
1.6	Pitch System	Blade pitch control system to achieve optimum blade angle for individual wind and rotational speed condition. Each blade is controlled by a motor. Power by either hydraulic or electric housing in the nacelle. Backup by hydraulic accumulator for power failure condition.

2	Tower Components	
2.1	Tower Foundation	Supports the tower and transfers the loads to the foundation soil, or bedrock (in case of drilled pile). May be piled or may be concrete base, or fixed platform space frame.
2.2	Transition Piece (including grouting)	Complex steel piece to go, for example between foundation and tower to assure the tower is vertical within tight tolerance. Often grouted to pile, and tower is bolted to transition piece. Has attachements of J-tubes to protec the cable from boat impact, crew landing area for embarkation, ladders etc. attached on outside. May have shear connectors inside.
2.3	Tower	Typically made of rolled, tubular steel, and built and shipped in sections, connected with bolts or welded. Common towers include a ladder for access to the nacelle.
2.4	Tower Structural Connection (e.g. Bolt) Components	Flange and bolt or flange and weld. Tolerances with fit-up are critical as it affects dynamics of tower..
2.5	Foundation Coating & Cathodic Protection; Transition Piece and Tower	Paint or anodes; Paint may be 3 part epoxy- must be applied under correct temperature and humidity condition to a prepared surface.
2.6	Tower Coating	Paint above water; May be 3-part epoxy. Must be carefull applied; Has deteriorated very early on several tower installations.

4	Balance of System Components	
4.1	Crane	Sometimes a crane is on board the tower to help deal wit changing out parts i.e. generators, gearboxes etc.
4.2	Transformer for power production	Steps up voltage transmission in the collector line to covert energy generated by the turbine in to useable electricity for utility grids
4.3	Cables to shore-Elect Control from shore systems	Electrical transmission cables to take the electricity to shore either from the transformer platform or from the turbines (if close to shore).
4.4	In Field Cables - Control & Electrical offshore Systems only	Electrical transmission cables to take 32KV AC Power from the tower either to shore or to a transformer station in the field that steps up the voltage and/or changes to DC.

3	Nacelle Components	
3.1	Nacelle Frame	Outer frame to protect the machinery on top of the tower from the external environment; sometimes it houses an area to deposit and pick up personnel by helicopter
3.2	Nacelle Cover and Spinner/Housing	Cover for the nacelle or rotor to protect the equipment from the environment. Nacelle is often an air conditioned space.
3.3	Gearbox including Bearings & Lube System	Converts low-speed rotation from the input shaft of the rotor to high-speed rotation, which drives the high-speed shaft of the generator assembly.
3.4	Internal Turbine/ Transformer Station Cables /and Cables that are part of control system	Cables that run inside the tower
3.5	Generators including Bearings	Generator converts mechanical energy into electricity.
3.6	Cooling Heating Dehumidification.	Equipment often used in the offshore wind turbine to avoi salt atmosphere deterioration of bearings and other mechanical equipment
3.7	Switchgear and Protection Equipment	Part of the electrical protection system. Protection equipment ensures that workers are safe as they maintai the system
3.8	Brakes	A mechanical friction brake and its hydraulic system hal the turbine blades during maintenance and overhaul. Brakes must be carefully calibrated to decelerate the blade so that it is not overloaded. A hydraulic disc brake on the yaw mechanism maintains nacelle position when nacelle is stationary
3.9	Locking Device	A device to lock the blades against rotation during maintenance when personnel may go into the hub
3.10	Yaw System	The yaw drive rotates (slews) the nacelle on the tower int the prevailing wind during production of electricity. It also rotates the nacelle during storms to ensure the direction remains within the design envelope.
3.12	Battery	Power provided to the yaw gear to orient the nacelle so to minimize the load on the tower during a storm. 6 hrs is determined by the IEC code to be a suitable time to have to support the yaw gear with power to survive a storm. Japanese requirements are longer determined by a Mont Carlo simulations.
3.13	Backup Power	Depending on the design it may be a generator on the transformer platform, or a supply of power from shore to maintain the turbine's direction during a storm.
3.14	Condition Monitoring & Software System	Electronics and software to monitor vibrations and other signals to ensure that unusual structural/mechanical behavior is noticed in order to effect maintenance before major damage.
3.15	Control Monitoring & Software System	Electronics and software to change modes during low rotation speed, or high rotation speed, and for emergency shutdown.
3.16	Converters	Changes AC power to DC Power.
3.17	Medium/High Voltage Components	Medium: Typically components < 50kV.

DRAFT Surveillance CVA Activities

		CVA Fabrication Activities		CVA Installation Activities: Loadout-Transportation-Lifting	CVA Installation Activities: Installation	CVA Installation Activities: Commissioning
0	**DEFINITIONS**	**Option 1 - Fabrication Check: (Type Cert.-accredited org.)** - Ensure per Facility Design Report -Type Certification for specific mfct location (Check Certification paperwork to ensure no exclusions in certs)	Option 2 - Fabrication Check: (No Type Cert.) - Ensure per Facility Design Report. - Certified welder; Certified materials; Quality, Traceability, Weld Specs.; - Review of records, NDT and FAT as applicable (Check visually "suitable"%: ramp % up or down with experience) - Repair per Spec.	Loadout/Transportation & Lifting Check: - Ensure sign-off by Fabrication CVA - Attend first loadout/transport at marshalling area & offshore lift ("suitable"% thereafter) Visual "suitable"% at marshalling area prior to & during offshore loadout. - Conduct first batch site arrival survey & lift arrangement; (Ramp % up or down with experience) - Inspect before installation. (Verify mfct. lifting arrangements match the site situation)	Installation Check: - Final fitup and dimensional control (mainly tower and transitional pieces) checks; - Attend/witness first Installation and subsequently "suitable"%; ramping up or down as appropriate (Welding Connection: "suitable"% Visual inspection; ramp % up or down with experience) (Bolting Connection - see below) - Review of NDT records. - Ensure no damages or repaired to spec. - Ensure Records are kept (e.g. pile driving, bolt torque, grouting records etc.)	Commissioning Check: Attend first and then "a suitable" of Commissioning tests or as per discretion of CVA.
1	**ROTOR COMPONENTS**					
1.1	**Hub**	**Fabrication Check Option 1 Applicable**	**Fabrication Check Option 2 Applicable** (If equip is not type cert.)	-NA-	Visual Observation only	-NA-
1.2	**Extender**	**Fabrication Check Option 1 Applicable**	**Fabrication Check Option 2 Applicable** (If equip is not type cert.)	-NA-	-NA-	-NA-
1.3	**Blades**	**Fabrication Check Option 1 Applicable** Manufacturing Location-Specific Type Certification acceptable.	-NA-	**Transportation Check Applicable**; Approves transport manual if not approved by type certifier. Check appropriateness and method of lifting to ensure no overload.	**Installation Check Applicable**	-NA-
1.4	**Blade Bolting**	-NA-	Check bolt spec and confirm quality of bolt. (If suspect, request check of metallurgy)	-NA-	**Installation Check Applicable**; Spot Check Torques Competence/Qualification check of person installing: Has Torque Wrench; Calibrates at start; Follows suitable Re-calibration requirements (e.g. after drop, daily), trained and bolt torque recorded. (Reference requirements in AISC 8th Edition Pg 5-216 or equivalent.)	**Commissioning Check Applicable**
1.5	**Blade Coating**	-NA-	-NA-	-NA-	-NA-	-NA-
1.6	**Pitch System**	**Fabrication Check Option 1 Applicable**	**Fabrication Check Option 2 Applicable** (If equip is not type cert.)	-NA-	-NA-	**Commissioning Check Applicable**
2	**TOWER COMPONENTS**					
2.1	**Tower Foundation**	-NA-	**Fabrication Check Option 2 Applicable** (If Concrete CVA to check quality control of concrete and check sample tests)	**Transportation Check Applicable**	**Installation Check Applicable**	-NA-
2.2	**Transition Piece (incl. Grouting)**	-NA-	**Fabrication Check Option 2 Applicable**	**Transportation Check Applicable**	**Installation Check Applicable** AISC bend check on % of the studs. Grouting checked in same vein. Examine Grout test sampled and confirmed in spec.	-NA-
2.3	**Tower**	-NA-	**Fabrication Check Option 2 Applicable**	**Transportation Check Applicable**	**Installation Check Applicable**	-NA-
2.4	**Tower Structural Connection (e.g. Bolt) Components**	-NA-	**Fabrication Check Option 2 Applicable** **Ensure spec. on bolts is met and other structurally critical components.** **Check fit-up of first then "a suitable" surveillance.**	-NA-	**Installation Check Applicable** Competence/Qualification check of person installing: Has Torque Wrench; Calibrates at start; Follows suitable Re-calibration requirements (e.g. after drop, daily), trained and bolt torque recorded. (Reference requirements in AISC 8th Edition Pg 5-216 or equivalent.)	-NA-
2.5	**Foundation Coating & Cathodic Protection; Transition Piece and Tower**	-NA-	**Fabrication Check Option 2 Applicable.** Coating specification, quality record for adhesion and thickness tests	NA Except if damage noted;	**Installation Check Applicable**	-NA-
2.6	**Tower Coating**	-NA-	**Fabrication Check Option 2 Applicable**	NA Except if damage noted;	-NA-	-NA-
3	**NACELLE COMPONENTS**					

DRAFT Surveillance CVA Activities

		CVA Fabrication Activities		CVA Installation Activities		
				Loadout-Transportation-Lifting	Installation	Commissioning
0	**DEFINITIONS**	**Option 1 - Fabrication Check: (Type Cert.-accredited org.)** - Ensure per Facility Design Report -Type Certification for specific mfct location (Check Certification paperwork to ensure no exclusions in certs)	Option 2 - Fabrication Check: (No Type Cert.) - Ensure per Facility Design Report. - Certified welder; Certified materials; Quality, Traceability, Weld Specs.; - Review of records, NDT and FAT as applicable (Check visually "suitable"%: ramp % up or down with experience) - Repair per Spec.	Loadout/Transportation & Lifting Check: - Ensure sign-off by Fabrication CVA - Attend first loadout/transport at marshalling area & offshore lift ("suitable"% thereafter) Visual "suitable"% at marshalling area prior to & during offshore loadout. - Conduct first batch site arrival survey & lift arrangement; (Ramp % up or down with experience) - Inspect before installation. (Verify mfct. lifting arrangements match the site situation)	Installation Check: - Final fitup and dimensional control (mainly tower and transitional pieces) checks; - Attend/witness first Installation and subsequently "suitable"%; ramping up or down as appropriate (Welding Connection: "suitable"% Visual inspection; ramp % up or down with experience) (Bolting Connection - see below) - Review of NDT records. - Ensure no damages or repaired to spec. - Ensure Records are kept (e.g. pile driving, bolt torque, grouting records etc.)	Commissioning Check: Attend first and then "a suitable" of Commissioning tests or as per discretion of CVA.
3.1	**Nacelle Frame**	-NA-	-NA-	NA Except if damage noted;	**Installation Check Applicable**	-NA-
3.2	**Nacelle Cover and Spinner/ Housing**	-NA-	-NA-	NA Except if damage noted;	**Installation Check Applicable**	-NA-
3.4	**Gearbox incl. Bearings & Lube System**	-NA-	-NA-	-NA-	-NA-	**Commissioning Check Applicable**
3.5	**Internal Turbine/ Transformer Station Cables /and Cables that are part of control system**	-NA-	**Fabrication Check Option 1 Applicable**; CVA Check manufacturer has provided acceptable documentation that components are designed manufactured and tested in accordance with an applicable standard or code.	NA Except if damage noted;	-NA-	**Commissioning Check Applicable**
3.6	**Generators incl. Bearings**	-NA-	-NA-	-NA-	-NA-	**Commissioning Check Applicable**
3.7	**Cooling Heating Dehumidification.**	-NA-	-NA-	-NA-	-NA-	-NA-
3.8	**Switchgear and Protection Equipment**	-NA-	**Fabrication Check Option 2 Applicable** Certified or FAT; CVA Check manufacturer has provided acceptable documentation that components are designed manufactured and tested in accordance with an applicable standard or code.	-NA-	-NA-	**Commissioning Check Applicable**
3.9	**Brakes**	-NA-	-NA-	-NA-	-NA-	**Commissioning Check Applicable** Since integrity of blades depend on
3.10	**Locking Devices for Maintenance**	-NA-	-NA-	-NA-	-NA-	-NA-
3.11	**Yaw System**	**Fabrication Check Option 1 Applicable** Checks typical of gears/ motors etc.	Fabrication Check Option 2 Applicable	-NA-	-NA-	**Commissioning Check Applicable.** Check no damage. Check tolerances
3.12	**Transformers if part of yaw system**	**Fabrication Check Option 1 Applicable**	**Fabrication Check Option 2 Applicable** (If equip is not type cert.)	-NA-	-NA-	**Commissioning Check Applicable**
3.13	**Battery**	-NA-	**Fabrication Check Option 2 Applicable**	-NA-	-NA-	**Commissioning Check Applicable**
3.14	**Condition Monitoring & Software System**	-NA-	-NA-	-NA-	-NA-	-NA-
3.15	**Control Monitoring & Software System**	-NA-	-NA-	-NA-	-NA-	**Commissioning Check Applicable**
3.16	**Converters**	-NA-	-NA-	-NA-	-NA-	-NA-
3.17	**Medium & High Voltage Components**	-NA-	-NA-	-NA-	-NA-	-NA-

DRAFT Surveillance CVA Activities

		CVA Fabrication Activities		CVA Installation Activities: Loadout-Transportation-Lifting	CVA Installation Activities: Installation	CVA Installation Activities: Commissioning
0	**DEFINITIONS**	**Option 1 - Fabrication Check: (Type Cert.-accredited org.)** - Ensure per Facility Design Report -Type Certification for specific mfct location (Check Certification paperwork to ensure no exclusions in certs)	Option 2 - Fabrication Check: (No Type Cert.) - Ensure per Facility Design Report. - Certified welder; Certified materials; Quality, Traceability, Weld Specs.; - Review of records, NDT and FAT as applicable (Check visually "suitable"%: ramp % up or down with experience) - Repair per Spec.	Loadout/Transportation & Lifting Check: - Ensure sign-off by Fabrication CVA - Attend first loadout/transport at marshalling area & offshore lift ("suitable"% thereafter) Visual "suitable"% at marshalling area prior to & during offshore loadout. - Conduct first batch site arrival survey & lift arrangement; (Ramp % up or down with experience) - Inspect before installation. (Verify mfct. lifting arrangements match the site situation)	Installation Check: - Final fitup and dimensional control (mainly tower and transitional pieces) checks; - Attend/witness first Installation and subsequently "suitable"%; ramping up or down as appropriate (Welding Connection: "suitable"% Visual inspection; ramp % up or down with experience) (Bolting Connection - see below) - Review of NDT records. - Ensure no damages or repaired to spec. - Ensure Records are kept (e.g. pile driving, bolt torque, grouting records etc.)	Commissioning Check: Attend first and then "a suitable" of Commissioning tests or as per discretion of CVA.
4	**BALANCE OF SYSTEM COMPONENTS**					
4.1	**Crane**	-NA-	-NA-	-NA-	-NA-	-NA-
4.2	**Transformers for power production**	-NA-	-NA-	-NA-	-NA-	-NA-
4.3	**Cables to Shore - Electrical & Control from shore Systems only**	-NA-	Factory acceptance not usually carried out on the cables prior to installation. Check manufacturer has provided acceptable documentation that components are designed manufactured and tested in accordance with an applicable standard or code	NA Except if damage noted;	**Installation Check Applicable;** Cables are checked in detail for critical systems. Check to ensure the depth is measured; cable is protected from rocks; and records of depth and position are accurately recorded and records retained. If structure depends on the power to shore if backup battery fails and thus the cables to shore are in the potential structural loadpath.	-NA-
4/4	**In Field Cables - Control & Electrical offshore Systems only**	-NA-	Factory acceptance not usually carried out on the cables prior to installation. Check manufacturer has provided acceptable documentation that components are designed manufactured and tested in accordance with an applicable standard or code	NA Except if damage noted;	**Installation Check Applicable**; Check to ensure the depth is measured; cable is protected from rocks; and records of depth and position are accurately recorded and records retained. Cables are checked in detail for critical systems. If structure depends on the power to shore if backup battery fails and thus the infield cables are in the potential structural loadpath.	-NA-
4.5	**Backup Power**	-NA-	**Fabrication Check Option 2 Applicable**	-NA-	-NA-	**Commissioning Check Applicable**

APPENDIX K: DESIGN CVA WORKSHEET

Presented by Malcolm Sharples (ORTC)

#	Items of Design Information	Proposed CVA Activity
	Early Data Gathering - CVA Design Evaluation - if Appointed	
S A P	**Metocean** (possibly Seasonal) - 100- year airgap	Verify Plausibility - consider exposure
	Soil	Verify Plausibility / Suitability
	Site Specific Analysis - (example standards: API RP2A, BWEA Guidelines Jackups, or Certification from Marine Warranty Surveyor) per Facility Design Report	Verify the plausibility. Review USCG Approved Marine Operating Manual ; **Comply API 95J or API RP2A airgap** depending on the type of vessel/platform/ installation. Deal with it per Oil & Gas Cva Requirements if Fixed Platform.
	Construction Phase	
C O P	**Metocean** (possibly Seasonal)	- Verify Plausibility - Rationalize the difference between oil & gas practice [**10-yr seasonal** for temporary construction vs. **1-year** for wind farm per IEC - DLC 8.2] - e.g. sudden hurricane; Depends on length of activity
	Soil	Verify Plausibility / Suitability
	Seafastening and Marine Operations Design Criteria	Not CVA
C O P	Road accident on way to Construction site	Not CVA
	Lifting - Certification, Rigging Certification, and Lift Procedures	- CVA reviews manufacturer's lifting procedure and notes if it is not carried out (for larger (?) items only); - CVA checks plausibility of values/assumptions.
	Cable Burial - verify Permit	- Plausibility of Cable Burial Depth as noted in Facility Design Report - Reviews and Comments on Installation procedures-for residual damage. - CVA reviews warning signage for cables, both temporary and permanent. - CVA comments on documentation to be provided to know the precise as-built route.

#	Items of Design Information	Proposed CVA Activity
	Design Phase	**Details**
7	Lighting and Emergency Lighting	Not CVA
8	Gearbox	Not CVA
8	**Pitch System** - Parking for Extremes	Per Type Approval
8	Lubricants	Not CVA
9	Lightning Protection	Not CVA- Controversial
10	Fire Detection / Fire Alarm	Not CVA
11	Fire Protection Permanent Devices (Automation) Suppression Devices Portable Devices	Not CVA
12	Security	Not CVA
13	On-Board Crane	Not CVA - Loads applied to structure YES
14	Personal Protection: Access in Tower; Ladders with Fall Arrest; Climb Assist; Intermediate Platforms; Escape	Not CVA see Safety Management System (SMS)
14	Elevator (if present)	Not CVA
14	Lifesaving	Not CVA
15	Navigation Lights/ Sounds	Not a CVA function? USCG
16	Access to Tower or other structure: Design for Boarding from Boat or Helicopter	Not CVA
17	Condition Monitoring system	Not CVA
17	Condition for Icing and Ice Throw	Not CVA
22	Waste and Sewage System (if installed)	Not CVA
22	Potable Water System (if installed)	Not CVA
23	Noise Requirements (testing etc)	Not CVA
26	Means of Escape	Not CVA
27	Communications Permanent Equipment (if any installed)	Not CVA

#	Items of Design Information	Proposed CVA Activity
27	Communications Portable Equipment	Not CVA
1	**Site Specific Metocean /Seismic** etc. (wind, wave, current, waterlevel etc.) per NOAA or other standard equivalent if a TRS site; 50/100 year winter storm data; 100-year airgap.	Verify Plausibility including: Extremes, Scatter Diagrams, Breaking Waves, Temperatures, Marine Growth,etc. (may require an independent check).
2	Site Specific Soil Data	Verify Plausibility and extent/quality of soil information; precautions e.g. Scour - checking suitable vessels and suitable experience of samplers.
2	**Penetration** of Foundation	Verify Plausibility of depth of boring
2	**Shallow Hazard Survey**	Consider effect (if any) on design - uniformity, variability, geologic hazards that could affect design, installation.
2	**Soil** data to determine Anchor Suitability	Verify plausibility of anchor embedment/ capability for stationkeeping based on loads and soil type.
3	**Structural Analysis**	CVA attends FMEA or HAZID - and reports Verify Plausibility: Load assumptions vs results of exemplary calcs. using code specified in Facility Design Report Vibration methods incorporated into design; Dynamic action of wind wave & current and other loads considered. Floating: **stability; mooring** components design and condition monitoring etc. 30 CFR § 285.701. as per CVA guidelines for floating platforms.

#	Items of Design Information	Proposed CVA Activity
3	**Tower**	Verify Plausibility of Structural Analysis for load cases which could damage tower; Confirm emergency shut down does not damage blades; Confirm loads from tower match foundation assumptions; Verify plausibility of icing considerations;
3	**Fatigue** of welded connections	Verify Plausibility loading assumptions, S-N curves used vs. exemplary calculations.
3	Requirements for **Bolted connections**	Bolt specification appropriate e.g. material, fatigue characteristics; flange design.
3	**Grouted connections**	Verify Plausibility of assumptions; Ensure appropriate shear studs, and verify values etc. Verify Spec. of bend tests on studs.
3	Support Structure/ **Foundation** (incl. Dynamics)	Verify loads match tower loads; Plausibility of assumptions and analysis results; If concrete, ensure suitability of codes for loading situation e.g. regardless of code requirements ensure code suitable for arrangements.
3	**Bucket anchors**	Verify Plausibility of assumptions, analysis and results
3	**Mooring** Capability for floating structures	Verify Plausibility of assumptions, analysis and results

#	Items of Design Information	Proposed CVA Activity
3	Structural Analysis for **Transportation** mode and **Installation** loads	Opines on the criteria? 10-year vs. 1 year - DLC 8.2? Opines on Manufacturer's criteria **Loadout/ Transport/Lift**? Reviews manufacturer's criteria to observe at site?
3	**Collision** Criteria for Design	Attends the **FMEA/HAZID**; Reports on results; Opines on appropriateness in report to BOEMRE? - or is this BOEMRE function?
4	**Blades Design** against overspeed	Verify type Certificate compared to actual conditions and for control system; Brakes provide appropriate deceleration.
4	**Blades Design** against Extreme Wind;	Spot checks for plausibility? Verifies design by repeating the calculations as called for in the IEC Code. -22 8.3.3. "The Certification Body shall evaluate the loads and load cases for compliance with IEC 61400-1, IEC 61400-2 or IEC 61400-3 by independent analysis"
4	**Blades Test for Site Conditions**	Review Tests - and Report difference between Tests and Site
4	**Blades: Design against fatigue**	Verify Plausibility of Calculation results and tests for site application.
4	**Blades Deflection** to prevent interferences with Tower	Check proximity in any extreme condition. Ensure information contained in Operating Manual. (GL Certification 2005 specifies 4.7.3.7.1.2; Other references may be appropriate).

#	Items of Design Information	Proposed CVA Activity
5	**Floating Hull**: Hull conditions floating - Not CVA Ballast System details- Not CVA Vents & Soundings- Not CVA Ventilation System- Not CVA Leak Detection- Not CVA Level and Gauging System- Not CVA	Verifies Structural Calculations against site loads including extremes, airgaps, strength, fatigue. Verifies Stability calculations for plausibility or repeats calculations?
6	**Corrosion Protection** (285.709)	Review and Confirm Suitability of Corrosion protection system: Paint at Splash Zone; anodes below water; not Blades.
17	**Software** Verification for Control System	Review and report on logic. Confirm system where authorized changes are recorded; Ensure system to ensure up-to-date software is used i.e. recorded log of changes.
18	**Remote Operation**	Verify system to ensure shut down for survival, and all hardware/software involved.
18	**Emergency Shut Down System** - Icing - Storm - Blade Failure - Power Failure - Fire - Other	Verify system(s) to ensure detection and shut down for survival, and all hardware/software involved.
19	**Transformers** - in substation and turbine and Switchgear	Not CVA unless power req'd for shutdown or yaw

#	Items of Design Information	Proposed CVA Activity
24	**Cable** Information incl. burial requirements	Not CVA - unless req'd for shutdown: if so, examine risk of protection in storm in HAZID
24	**Fiber Optic Cables**	Not CVA - unless req'd for shutdown: if so, examine risk of protection in storm in HAZID
25	Ventilation System	Not CVA
28	**Transformer Platform Installation** Additional points (above information also applies)	Verify loadout/ transportation/ installation per oil and gas platforms Including Design.
	Non Design Issues	
30	Signage	Description of Turbine Number, Location, Size etc. 30 CFR 250.154 - Not CVA
31	Periodic Assessment	Not CVA

APPENDIX L: RECOMMENDATIONS:

Load Cases from IEC

Recommendations to BOEMRE from the Workshop

Parking Lot Items

Review of Load Cases

Recommend: Add Load Cases in conjunction with Stakeholder HAZID at the beginning of the Project

Table 1 – Design load cases

Design situation	DLC	Wind condition	Waves	Wind and wave directionality	Sea currents	Water level	Other conditions	Type of analysis	Partial safety factor
1) Power production	1.1	NTM $V_{in} < V_{hub} < V_{out}$ RNA	NSS $H_s = E[H_s \| V_{hub}]$	COD, UNI	NCM	MSL	For extrapolation of extreme loads on the RNA	U	N (1,25)
	1.2	NTM $V_{in} < V_{hub} < V_{out}$	NSS Joint prob. distrbution of H_s, T_p, V_{hub}	COD, MUL	No currents	NWLR or ≥ MSL		F	*
	1.3	ETM $V_{in} < V_{hub} < V_{out}$	NSS $H_s = E[H_s \| V_{hub}]$	COD, UNI	NCM	MSL		U	N
	1.4	ECD $V_{hub} = V_r - 2$ m/s, V_r, $V_r + 2$ m/s	NSS (or NWH) $H_s = E[H_s \| V_{hub}]$	MIS, wind direction change	NCM	MSL		U	N
	1.5	EWS $V_{in} < V_{hub} < V_{out}$	NSS (or NWH) $H_s = E[H_s \| V_{hub}]$	COD, UNI	NCM	MSL		U	N
	1.6a	NTM $V_{in} < V_{hub} < V_{out}$	SSS $H_s = H_{s,SSS}$	COD, UNI	NCM	NWLR		U	N
	1.6b	NTM $V_{in} < V_{hub} < V_{out}$	SWH $H = H_{SWH}$	COD, UNI	NCM	NWLR		U	N

Table 1 – Design load cases *(continued)*

Design situation	DLC	Wind condition	Waves	Wind and wave directionality	Sea currents	Water level	Other conditions	Type of analysis	Partial safety factor
2) Power production plus occurrence of fault	2.1	NTM $V_{in} < V_{hub} < V_{out}$	NSS $H_s = E[H_s \| V_{hub}]$	COD, UNI	NCM	MSL	Control system fault or loss of electrical network	U	N
	2.2	NTM $V_{in} < V_{hub} < V_{out}$	NSS $H_s = E[H_s \| V_{hub}]$	COD, UNI	NCM	MSL	Protection system or preceding internal electrical fault	U	A
	2.3	EOG $V_{hub} = V_r \pm 2$ m/s and V_{out}	NSS (or NWH) $H_s = E[H_s \| V_{hub}]$	COD, UNI	NCM	MSL	External or internal electrical fault including loss of electrical network	U	A
	2.4	NTM $V_{in} < V_{hub} < V_{out}$	NSS $H_s = E[H_s \| V_{hub}]$	COD, UNI	No currents	NWLR or ≥ MSL	Control, protection, or electrical system faults including loss of electrical network	F	*
3) Start up	3.1	NWP $V_{in} < V_{hub} < V_{out}$	NSS (or NWH) $H_s = E[H_s \| V_{hub}]$	COD, UNI	No currents	NWLR or ≥ MSL		F	*
	3.2	EOG $V_{hub} = V_{in}, V_r \pm 2$ m/s and V_{out}	NSS (or NWH) $H_s = E[H_s \| V_{hub}]$	COD, UNI	NCM	MSL		U	N
	3.3	EDC_1 $V_{hub} = V_{in}, V_r \pm 2$ m/s and V_{out}	NSS (or NWH) $H_s = E[H_s \| V_{hub}]$	MIS, wind direction change	NCM	MSL		U	N

Table 1 – Design load cases *(continued)*

Design situation	DLC	Wind condition	Waves	Wind and wave directionality	Sea currents	Water level	Other conditions	Type of analysis	Partial safety factor
4) Normal shut down	4.1	NWP $V_{in} < V_{hub} < V_{out}$	NSS (or NWH) $H_s = E[H_s \| V_{hub}]$	COD, UNI	No currents	NWLR or ≥ MSL		F	*
	4.2	EOG $V_{hub} = V_r \pm 2m/s$ and V_{out}	NSS (or NWH) $H_s = E[H_s \| V_{hub}]$	COD, UNI	NCM	MSL		U	N
5) Emergency shut down	5.1	NTM $V_{hub} = V_r \pm 2m/s$ and V_{out}	NSS $H_s = E[H_s \| V_{hub}]$	COD, UNI	NCM	MSL		U	N
6) Parked (standing still or idling)	6.1a	EWM Turbulent wind model $V_{hub} = k_1 V_{ref}$	ESS $H_s = k_2 H_{s50}$	MIS, MUL	ECM	EWLR		U	N
	6.1b	EWM Steady wind model $V(z_{hub}) = V_{e50}$	RWH $H = H_{red50}$	MIS, MUL	ECM	EWLR		U	N
	6.1c	RWM Steady wind model $V(z_{hub}) = V_{red50}$	EWH $H = H_{50}$	MIS, MUL	ECM	EWLR		U	N
	6.2a	EWM Turbulent wind model $V_{hub} = k_1 V_{ref}$	ESS $H_s = k_2 H_{s50}$	MIS, MUL	ECM	EWLR	Loss of electrical network	U	A
	6.2b	EWM Steady wind model $V(z_{hub}) = V_{e50}$	RWH $H = H_{red50}$	MIS, MUL	ECM	EWLR	Loss of electrical network	U	A
	6.3a	EWM Turbulent wind model $V_{hub} = k_1 V_1$	ESS $H_s = k_2 H_{s1}$	MIS, MUL	ECM	NWLR	Extreme yaw misalignment	U	N
	6.3b	EWM Steady wind model $V(z_{hub}) = V_{e1}$	RWH $H = H_{red1}$	MIS, MUL	ECM	NWLR	Extreme yaw misalignment	U	N
	6.4	NTM $V_{hub} < 0,7\ V_{ref}$	NSS Joint prob. distribution of H_s, T_p, V_{hub}	COD, MUL	No currents	NWLR or ≥ MSL		F	*

Table 1 – Design load cases *(continued)*

Design situation	DLC	Wind condition	Waves	Wind and wave directionality	Sea currents	Water level	Other conditions	Type of analysis	Partial safety factor
7) Parked and fault conditions	7.1a	EWM Turbulent wind model $V_{hub} = k_1 V_1$	ESS $H_s = k_2 H_{s1}$	MIS, MUL	ECM	NWLR		U	A
	7.1b	EWM Steady wind model $V(z_{hub}) = V_{e1}$	RWH $H = H_{red1}$	MIS, MUL	ECM	NWLR		U	A
	7.1c	RWM Steady wind model $V(z_{hub}) = V_{red1}$	EWH $H = H_1$	MIS, MUL	ECM	NWLR		U	A
	7.2	NTM $V_{hub} < 0{,}7\ V_1$	NSS Joint prob. distribution of H_s, T_p, V_{hub}	COD, MUL	No currents	NWLR or ≥ MSL		F	*
8) Transport, assembly, maintenance and repair	8.1	To be stated by the manufacturer						U	T
	8.2a	EWM Turbulent wind model $V_{hub} = k_1 V_1$	ESS $H_s = k_2 H_{s1}$	COD, UNI	ECM	NWLR		U	A
	8.2b	EWM Steady wind model $V_{hub} = V_{e1}$	RWH $H = H_{red1}$	COD, UNI	ECM	NWLR		U	A
	8.2c	RWM Steady wind model $V(z_{hub}) = V_{red1}$	EWH $H = H_1$	COD, UNI	ECM	NWLR		U	A
	8.3	NTM $V_{hub} < 0{,}7\ V_{ref}$	NSS Joint prob. distribution of H_s, T_p, V_{hub}	COD, MUL	No currents	NWLR or ≥ MSL	No grid during installation period	F	*

IEC 61400-3

“In DLC 6.2 a loss of the electrical power network at an early stage in the storm containing the extreme wind situation, shall be assumed. Unless power back-up for the control and yaw system with a capacity of 6 hours of continuous operation is provided, the effect of yaw error of up to ±180 degrees shall be analysed.”

Conditions checked are:
reference wind speed and 50-year significant wave height (turbulent wind model) < ±8 yaw

50 year wind speed and associated wave (steady wind model) < ±15 yaw

If holding the yaw cannot be accomplished then the designer is forced to consider a ±180 degree yaw: the designer’s assumption is not recorded in the information provided in Annex A.

IEC 61400-3

“In DLC 6.3, the extreme wind with a 1-year recurrence interval shall be combined with the maximum yaw error (yaw tolerance). If not justified otherwise, a yaw error of up to ±30 degrees using the steady extreme wind model or ±20 degrees using the turbulent wind model (to be defined) shall be assumed”

Conditions checked are:

1-year wind speed and 1-year significant wave height (turbulent wind model) < ±20 yaw

1- year wind speed and 1-year associated wave (steady wind model) < ±30 yaw

Under this condition there is no requirement to check the ±180 degree condition.

Recommendations of the Workshop for BOEMRE

Recommendations

- CVA Timing of Involvement – Recommend prior to design a stakeholder HAZID be conducted to decide particular additional load cases for the project – and check limits of the Type Certification conditions
- Confirm the HAZID Requirement (in future Regulation/ NTLs Guidance etc.).
- Confirm Type Certification will be recognized with an Accredited Certifier – Accreditation is currently only practiced in Europe for wind farms
- Recommend that ANSI be encouraged to develop an US accreditation program. (EN ISO 17020 Standard may apply).
- ISO EN 17020 accreditation standard was reviewed after the workshop and it is thought not to be sufficient for the Type Certification certifier in that it does not have a strong area to check competence and since Certificates have to be recognized by potential competitive organizations the competence check needs to be tight.

Recommendations

- Recommend it is not necessary for CVA to Repeat Calculations as recommended per the IEC CODE. A Plausibility check may need a check on some load cases to spot check the methodology and results.
- CVA is not Involved in attendance at Soil Tests. A plausibility check is the interpreted requirement. Recommend BOEMRE provide additional guidelines for depth of boring, number of borings etc. (See slide 6 Bullet 2)
- Recommend the Transport CVA work starts at the Marshalling yard (meaning last port). For Loadout/ Transport/ Installation For Transformer Platform – see oil and gas CVA Requirements.
- The issue of CVA attendance for major modifications and major repairs was discussed and may need further study to list the types of situations that would give rise to the re-appointment of the CVA.

Recommendations

- Recommend BOEMRE look into a better definition/scope of CVA surveillance of Electrical System e.g. High Voltage Systems/ Buried Cables – if assured in another way by BOEMRE then the CVA role becomes a simpler and easier task related only to one engineering discipline.
- Note: BOEMRE is responsible for electrical reliability for structural integrity, environmental issues, life and worker Safety.
- In the Oil & Gas CVA related regulations (30 CFR 250.912) addresses the requirements of submitting the Design, Fabrication and Installation Verification Plans under the Platform Verification Program. There is no equivalent part of this requirement in the Wind Energy regulations. It is recommended that similar requirements be added to 30 CFR 285 Subpart G regulations which would enhance the enhancement of knowledge of the intent for the CVA and the performance.
- Recommend a training program with a complete procedure and checklist for handling CVA issues is to be developed for BOEMRE regional offices, especially East and West Coast Offices. The training program will be based on the BOEMRE experience in GOM.

Recommend the Change from “Certify” to “Ensure” that the structure survives for its design lifetime in 30 CFR 285.

- 701 d. the design of the structure has been verified by an MMS approved CVA (2 places).
- 702 c.- 2 places
- 705 1st para
- 707 a.
- 708 (5) and (ii) – 2 times
- 714 c.

Continued Recommendations

- Research on a Parametric Study of offshore wind turbines to determine critical load cases for the structure i.e. which component is critical from each Design Load Case.
- Research on a Parametric Study to determine how a variation in soil conditions effect on structural integrity: this is to determine how close the boreholes have to be in any particular wind farm to confirm the design. (Regs indicate from 30 CFR 250.907 that this is now 500 ft).
- At the commencement of the project it is recommended that a Kickoff meeting be held with the CVA by BOEMRE – and that a design, fabrication and installation verification plan be required as per the oil and gas requirements (250.912) which is missing from the renewable regs.
- For Floating platforms the Stability will need to be defined by BOEMRE and the weight certification should be one of the requirements. USCG normally reviews floating facilities but any requirements they may have for wind farms seemed uncertain.
- No recommendations were made regarding removal of these structures at the end of their lease or because of damage. There is additional risk to personnel and additional cost from salvage or recovery of damaged structures and this may need to be a subject of further study.

Additional Recommendation

(AWEA Contributed)

- Recommend a White Paper entitled, “BOEMRE Responsibilities for Renewable Energy Activities on the Outer Continental Shelf.” The White Paper would address such issues as:
  - Authorization for taking action (Energy Policy Act of 2005 (EPAct) (Pub. L. 109–58))
  - Scope of charge to BOEMRE (“Ensure that renewable energy activities on the OCS and activities involving the alternate use of OCS facilities for energy or marine-related purposes are conducted in a safe and environmentally sound manner” – from § 285.100 Authority)
  - Limits to BOEMRE authority (BOEMRE is to ensure safe and environmentally sound installations, but not to ensure that installations are economically viable; responsibilities to ensure a reliable supply of electricity from clean energy sources lie with other federal agencies, and are not within the scope of the charge to BOEMRE; limits of BOEMRE to ensure that the renewable energy activity is safe for the environment, not to ensure worker safety)
  - Boundaries of BOEMRE responsibilities (delineate respective responsibilities of authorities such as BOEMRE, Coast Guard, Department of Energy, Federal Energy Regulatory Commission, North American Electricity Reliability Council, Homeland Security, states, other jurisdictions; geographic boundaries, such as distances from shore, areas of the ocean covered by BOEMRE authority, exclusion from jurisdiction in fresh water (St. Lawrence Seaway, Great Lakes, for instance), etc.)
  - General charge to CVAs to help carry out the responsibilities of BOEMRE (the CVA activities are subjected to the scope and limits imposed on BOEMRE)

Parking Lot Items

Other Issues Discussed at the Workshop

Parking Lot

- Safety Management System Items
- Structurally Active vs. Structurally Passive
- Extremes for Tow /Installation 10 year
- Extremes for Design 50 vs 100 yr.
- Load out and Flotation
- Service Life Defined.
- Floating Structures USCG related issues e.g. Ballast, bilge, dam.stab., mooring

Parking Lot

- Backup Battery – or Backup Power

APPENDIX M: WORKSHOP PARTICIPANTS

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