Technical Report

International Offshore Energy Exploration and Production Profiles and Regulatory System Evaluation

August 4th, 2015

Prepared For:

Keith Petka
U.S. Department of the Interior
Bureau of Safety and Environmental Enforcement
Safety and Environmental Management Systems Branch
381 Elden St., Mailstop HE-3317
Herndon, VA 20170

Prepared By:

ICF International
9300 Lee Highway
Fairfax, VA 22031

Table of Contents

1 Executive Summary 1-1
2 Introduction 2-1
2.1 Scope 2-1
2.2 Approach and Methodology 2-1
2.3 Definitions & Abbreviations 2-4
3 Regulations and Regulatory Approaches 3-1
3.1 Country Regulatory Approaches 3-1
3.2 Country Statutory and Regulatory Requirements 3-4
3.3 Comparing and Contrasting Regulatory Polices and Approaches 3-5
4 Permitting Activities 4-1
5 Safety Management Systems 5-1
6 Offshore Operations Real time monitoring, Equipment failure reporting systems, and Accident near miss reporting 6-1
6.1 Real Time Monitoring of Offshore Operations 6-5
6.2 Equipment Failure Reporting Systems 6-15
6.3 Accident Near Miss Reporting 6-25
7 Shallow and Deepwater Permitting and Monitoring 7-1
7.1 Introduction 7-1
7.2 Well Control/Blowout Prevention 7-5
7.2.1 Summary 7-5
7.2.2 Well Barriers and Well Operations Plans 7-5
7.2.3 Blowout Preventer Permitting and Monitoring Requirements 7-7
7.3 Cementing Operations 7-10
7.4 Remotely operated Vehicles 7-18
8 Drilling and Production Activities Inspection Program 8-1
8.1 Inspection Program Overview 8-1
8.2 Training of Inspection Personnel 8-5
8.3 Equipment and Operations Inspected 8-5
8.4 Inspection Frequency 8-5
8.5 Non-Compliance Notification 8-6

8.6 Enforcement Tools 8-6
8.7 Priority Country Inspection Program Overviews - Drilling and Production Operations 8-7
9 Considerations Going Forward 9-1
10 APPENDIX 10-1
10.1 Special Considerations for Littoral Arctic Countries 10-1
10.2 Regulations/Statues Review by Country 10-5
10.3 Task 1 Summary and Findings 10-11
10.4 Priority Country and Regional Grouping Data Profile Reports 10-17
10.5 Additional Tables and Figures 10-18
10.6 References 10-31

1 Executive Summary

This report provides an analysis and comparison of the regulatory framework and requirements for 17 priority countries and focuses on a variety of key offshore regulatory areas ranging from permitting to shallow vs. deepwater considerations and safety management system requirements. Additionally, this analysis includes offshore oil and gas profiles for a broader group of countries given their proximity to major bodies of water.

Methods of analysis include subject matter expert, country-specific research, detailed review of key regulatory documents, frameworks to group countries according to relevant criteria, and qualitative and quantitative charts/figures. One objective in particular was to compare and contrast priority country regulatory systems identifying similarities and inconsistencies. Through this analysis, it was possible to provide an overall quality ranking of country approaches according to the areas analyzed. The main goal from this report was to identify opportunity areas for U.S. regulatory improvements and offer considerations that could be used to implement these potential changes. A summary of results of the research and analysis performed for the priority countries can be found below, grouped by major sub-task category. Bulleted lists of potential gaps in the U.S. regulatory system or other highlights are included for each sub-task. Each bullet represents an aspect of the sub-task that could be reviewed as an alternative approach or best practice with consideration to the U.S. regulatory system.

Permitting of Phases of Offshore Operations

Permitting for offshore operations falls under traditional and non-traditional style systems. Traditional systems are more prescriptive and typically involve physical documents for authorization to perform an activity. The United States generally follows this approach. Non-traditional systems can be characterized by a safety case or by a plan based method. Countries like the UK, Norway and Australia follow these non-traditional approaches, whereby discrete phases of offshore operations are not explicitly permitted, but through the approval of the safety case itself the operator is permitted to operate across the offshore phases of operations. Countries like the United States explicitly require, permits for several phases of offshore operations in their regulations, while other countries such as the United Kingdom do not have such prescriptive requirements. UK regulation implicitly requires permitting of specific offshore phases through the implementation of safety cases. It is important to note that a safety case approach does not mean an absence of prescriptive requirements; safety case analysis is required to demonstrate that the operation will meet technical standards that may include prescriptive standards. The contrast between the U.S. approach and the safety case approach is that in the U.S. approach more or less everything is a prescriptive requirement

Identified Alternative Approaches or Best Practices

- Safety case permitting approach:
  - Develop installation specific major hazard and consequence identification, rather than an entirely generic hazard and consequence identification approach. These major hazards and consequences are likely to change over a typical installation

lifecycle, e.g., significant modifications from falling reservoir pressure, both topsides and downhole. In safety case regimes, such as the UK, operators are responsible for identifying "material changes" over the course of an installation's lifetime which then need to be described in a revised safety case. The revised document must be submitted ahead of the proposed "material" change to the UK HSE (the safety case is reviewed every 5 years on scheduled basis), who may either accept or require further clarification regarding the proposal(s).

- Develop installation- specific controls (prevent + control + mitigate) as needed, to reduce residual risks to ALARP (As Low as Reasonably Practicable), resulting in a list of 'safety & environmental critical elements'.
- Develop installation specific performance standards for critical elements, plus a verification process to ensure these standards continue to be achieved throughout the installation lifecycle. Operator/license-holder's defined performance standards can include the compliance with relevant international/national standards, but these standards are not in the Safety Case legislation.

- Different plan-based permitting approaches from other countries for describing the lifecycle of well operations. Examples include:
  - Submission and approval of a Well Operations Management Plan (WOMP) in Australia, whose purpose is to manage lifetime integrity [i]for all well activities. It is important to note that Australia does not follow a pure safety case approach as is the case in the UK. Australia requires plan submittals in addition to the safety case.
  - Submission of a notification of Well Operations in UK, with details of the well design, planned activities and operational controls, including a report from the independent Well Examiner (appointed by the operator/license-holder) relating to these operations regarding their examination of the well design and work plan, their findings, and any remedial action recommended.

Real Time Monitoring of Offshore Operations, Equipment Failure, and Accident Near-Miss Reporting

Real time monitoring is generally considered to be the use of high-tech equipment to collect and instantaneously analyze offshore operational data. Real time monitoring of offshore operations from remote locations/operations centers, a new industry phenomenon, involves the use of new technology, such as fiber optic cable connections between locations for data/information transfer. Operators must take into consideration the economic benefit analysis and potential for reduction of risk/SHE concerns when using real time monitoring technology. There are no explicit real time monitoring provisions with respect to the latest technological advancements for offshore operations on remote/onshore facilities for any of the priority countries, though many nations include more general monitoring guidelines for all types of offshore activities within regulations and/or Management Systems requirements. National regulations and guidelines may outline

[i] Plans can be life-cycle based and submitted plans can also be subject to periodic (scheduled) review. Plan submittals and safety cases are not static documents.

items such as performance standards for specific operations (e.g. well control or cementing operations), equipment or operational technical specifications, inspection/verification processes for equipment/operations, and/or communication/reporting between operators and regulators throughout certain operations/events.

Priority countries generally require operators to notify the offshore regulatory agencies and submit written reports detailing the events and measures taken to address any potential consequences regarding equipment failure reporting and accident near-misses. The Norwegian regulatory framework has several requirements for emergency notification systems on installations, as well as reporting requirements to regulators during drilling and other well activities. For accident near miss reporting, the Norwegian regulations stand out as near miss accidents and are not included as a separate category (as in other priority countries) but are included in the broader reporting framework.

Identified Alternative Approaches or Best Practices

- Incorporate safety case and plan-based regulatory elements to encourage operator documentation and incorporation of lessons learned/improvements for offshore operations monitoring, equipment failure, and accident-miss reporting.
    - For example, a Well Operations Management Plan (WOMP) addresses risks and controls for the lifecycle of a well's operations.
- Better communication between regulator and operator regarding equipment failures and accident near-miss reporting.
    - In general, countries with performance based regimes tend to naturally have more communication between the regulatory body and operator. An example of this is when countries define communication requirements and plans around equipment failure and according near-miss reporting. This open dialogue at the outset and during actual operations facilitates communications through the various phases of offshore operations.
    - Priority countries with accident near miss reporting regulatory requirements call for operators to: 1) Notify regulatory authorities in the case of offshore accident near misses (often including equipment failures) and 2) Submit reports describing the incidents, including root cause analysis. Countries with substantial near miss reporting requirements include Australia, New Zealand, the United Kingdom, Canada, and Norway.
    - Equipment failure reporting requirements in performance-based regimes tend to place the onus on operators in identifying and communicating major hazards/risks to regulators, which may not be explicitly required to be reported elsewhere in legislation. For example, in the United Kingdom, reporting is required for specific incidents (e.g. hydrocarbon releases, explosions),as well as situations where there is an immediate risk of an accident, defined as "a judgement made at the time given a number of factors, but the term is intended to convey an event which requires immediate physical action to regain control of the situation or to mitigate the consequences of a major accident (e.g. evacuation, shutting down a section of the plant or the entire installation, or stopping an activity)[1]."

- Increased operator monitoring and data collection on 'small failure' indicators, such as leaking well barriers, well kicks, small process hydrocarbon leaks/releases. These pre-cursors may be monitored, as major events themselves so the lack of them can lead to a false sense of security. A voluntary program example is in the UK where operators aim to meet targets for reducing hydrocarbon releases. In 2013, the UK HSE states that the offshore industry met its target of reducing hydrocarbon releases by 50% (by the date of the 25th anniversary of the Piper Alpha disaster) and established a further reduction target of 50% by April 2016[2].
- EU Offshore Directive (came into force July 2015 via national legislation for each affected country) requires EU-based duty holders to inform their national regulators about any major hazard event that occurs in their operations outside EU.

Permitting and Monitoring of Blowout Preventer (BOP), Cementing and Remotely Operated Vehicles (ROV) Activities for Shallow and Deepwater Operations

For this report, offshore operations are categorized as either shallow or deep, at a cutoff depth of 1,000 feet. Many priority countries have active deepwater exploration and production operations, though each country varies in the mix. Historically, exploration and production has moved from shallow towards deeper waters but this is also influenced by national ocean topography. With a few exceptions, the majority of nations do not have separate statutory/regulatory requirements for shallow and deepwater operations, so operators are expected to comply with all applicable regulations, regardless of water depth.

Identified Alternative Approaches or Best Practices

- Use of Safety Case and plan-based mechanisms to monitor/permit BOPs and cementing operations.
- Inclusion of installation–specific BOP and cementing practices details, as well as aspects of continual improvement of risk management plans for specific operations across a facility's lifecycle.
- The United States has the most prescriptive requirements for ROVs among priority countries, with the majority regulations not explicitly requiring for ROV use in offshore operations.

Drilling and Production Operations through an Inspections Program

Oversight of drilling and production operations through an inspection program allows the regulator to verify that all phases and aspects of operations are consistent with the agreed requirements, regardless of whether it's a performance based or prescriptive regulatory regime. Workplace inspections from the regulating body are a key element of any successful regime geared towards improving offshore operations. The more safety/health/environmentally-critical an equipment item or operation is, the more thorough will be the associated inspection program. This may be achieved either through increased frequency of inspections (albeit sometimes random) or increasingly severe repercussions for instances of non-compliance. This approach underpins focus on well pressure control equipment in many countries where, for example BOPs

(equipment level) are often required to be inspected in detail, in addition to more general inspections of drilling rigs (facility level).

However, whether the overall regulatory regime is prescriptive or performance based will determine how specific these inspection requirements are across priority countries. For example, in the U.S., there are some very specific requirements that must be carried out as part of the regulator's inspection program for specific equipment/systems (e.g. drilling and production facilities) with strict rules on recording and documenting the findings. Countries with a performance based approach will have, on average, less specific inspection program requirements, with much of the focus being on verifying that the operator is performing what was actually stated in their safety case. Inspections are typically randomly performed for offshore installations, though installations may be prioritized by the regulatory bodies for inspection based on criteria such as performance and compliance history, prior incidents/accidents, and operational characteristics/industry incident trends. All equipment and operations described in an operator's safety case are prioritized for inspections by regulatory bodies, ensuring safety critical functions are given priority.

Identified Alternative Approaches or Best Practices

- Focused regulatory and operator inspections on most important safety, health, and environmental (SHE) related equipment/infrastructure (i.e. equipment with the greatest impact on risk reduction, to ensure it continues to meet design performance standards).
    - For example, on safety critical elements (such as BOPs) identified in Safety Case regimes.
    - Risk-based inspection programs, prioritizing inspections based on regulator experience, along with information gathered and observations at other offshore installations.
- Proactive inspection priorities and programs based on anticipated trends in the offshore industry:
    - For example, the Norwegian Petroleum Safety Authority (PSA) releases offshore inspection priorities on its website and makes public audits performed on inspected installations.
    - The UK Health and Safety Executive (HSE) releases plans for, and reports the results anonymously "Key Programmes" to promote awareness and management of risks associated with aging offshore infrastructure.
- Use of third party verification/examination bodies to assess management of critical equipment/infrastructure at regular intervals for the lifetime of an installation. Note: these are process-based audits, rather than 'tick the box' paperwork inspections.

Safety and Environmental Management Systems or Programs (SEMS/SEMP)

A management system refers to a system of processes which guarantees that an organization/company fulfills all steps required to meet its objectives. In the realm of offshore SHE regulation, safety/environment management systems, as the title indicates, are designed to improve the safety of offshore installations and reduce risks to site personnel, the general populace, and the natural environment. To accomplish this, safety management system models

apply to all activities at an installation based on principles including identification of policies and objectives, adherence to standards/regulations, identification of hazards, personnel training, controls and risks, and processes for continual improvement, including monitoring, auditing, and corrective actions.

Over 50% of priority countries have some form of Safety/Environmental Management System requirements governing all upstream offshore operations. Remaining priority countries have little or no requirements with respect to SEMS/SEMP.

Identified Alternative Approaches or Best Practices

- Drive towards continual improvement of a duty holder's Safety & Environment Management System
    - Review and evaluate systemic improvements to a SEMS at regular intervals, including incorporation of lessons learned from incidents, non-conformances, offshore operations monitoring and both positive and negative findings from internal and external audits. Note: 'Improvement' can be to both 'effectiveness' (equals to better SHE results) and 'efficiency' (equals to similar results but with reduced resources, this becomes more important when SHE results move towards excellence).

Key Challenges in the Arctic

For littoral Arctic countries, operating in the Arctic Ocean presents some of the harshest environments for offshore activities. Remoteness, prolonged periods of ice coverage and darkness, fog, floating ice, lack of infrastructure, and extreme freezing temperatures are just some examples of the operational and logistical challenges encountered in the Arctic Ocean. Compounding the issue, offshore activity in the United States is dominated by the Gulf of Mexico. As a result of this focused oil and gas activity in temperate waters, current U.S. technology, standards and practices for offshore operations are more suited for those conditions. Finally, the presence of ice in the Arctic further exacerbates all recovery/remediation efforts in the event of an adverse event such as a blowout or an oil spill.

Post Macondo, littoral Arctic countries have made strides in identifying and developing regulatory standards that would be applicable to operations in the Arctic Ocean, but further steps can be taken to improve Arctic specific standards. While countries like Norway and Canada do not have explicitly written standards that apply to Arctic exploration, their regulatory standards are structured to allow operators to meet the overarching goals of the regulator by taking the necessary precautions to mitigate risks in unique operating environments. These countries have regulatory systems which incorporate significant performance-based procedures that emphasize an operator's role in appropriately planning and acting to minimize risk in offshore operations, regardless of location. Countries that do not rely on prescriptive standards and regulations encourage operators to innovate to address challenges in new operating environments. These types of regimes streamline expansion of offshore operations in newer locations, as operators do not have to gain approval for operations, based on newer or re-written standards or regulations. Essentially, countries may have "Arctic specific" requirements, albeit implicitly, whereas the

U.S. has proposed prescriptive standards for certain discrete areas that have yet to be approved. Companies, such as Shell, have engaged in innovative solutions to manage the complex production environment that exists when dealing with ice, fog, darkness, extreme temperatures, and limited infrastructure. Technologies will continue to improve at a rapid pace, and regulatory bodies will need to maintain their expertise and awareness of what innovations are on the cutting edge of the industry.

Identified Alternative Approaches or Best Practices

- Extreme weather, especially ice movement: Needs novel and highly-adapted technology to successfully manage resulting risks.
- Very slow natural remediation of environmental damage/effects: Creates major pressures from international & national non-governmental organizations (NGOs) not to permit offshore oil & gas exploration or production.
- Arctic geography results in greater potential for cross-international boundary impacts from major events than for other U.S. waters.
- Need to quickly share and implement lessons learned internationally on best practices or technologies to manage SHE hazards. Prescriptive legislative systems are poorly adapted to do this.

Considerations Going Forward

The future of offshore operations continues to present many uncertainties and unique challenges. The one constant is the fact that new operational areas and drilling environments will tend to evolve and be more complex and push technological boundaries. Considering this outlook, ICF offers these considerations going forward:

1. ***Continue to Pursue a Hybrid Based Regulatory System***
    a. Change the mindset to a safety case regime
    b. Build expertise and resources within BSEE
    c. Establish a "general duty of care" mantra for BSEE and the industry
2. ***Improve Monitoring and Reporting of Safety Indicators for Offshore Operations***
    a. Well kicks
    b. Number of cement failures
    c. Number of gas alarms
    d. Monitoring the effectiveness of barriers
    e. DP (Dynamic Positioning) station keeping effectiveness
    f. BOP reliability
    g. Near misses and general incident monitoring
3. ***Continue to Develop Arctic Specific Performance-Based Standards for Offshore Operations***
    a. Foster increased innovation on the part of industry to meet SHE goals while operating in Arctic subsea and metocean conditions

2 Introduction

The Bureau of Safety and Environmental Enforcement (BSEE) is in the process of finding technical, regulatory, and policy parallels for offshore oil and gas activities in other countries. This is to inform the BSEE management on how to enhance its regulatory policies and structure, with the end goal of better regulating and promoting the improvement of offshore safety and environmental protection. In addition to developing offshore oil and gas profiles for various groups of countries, BSEE will use this study to understand and document a smaller subset of countries' (henceforth referred to as *priority countries*) statutory and regulatory requirements. This evaluation will establish if regulatory programs across various countries are in agreement or disagreement. Special importance was given to new regulatory and operational challenges that may arise in Arctic exploration, as well as any new challenges in the Western Hemisphere. The overall study is divided into Task 1 and Task 2, with the details as follows:

Task 1

- Generate oil and gas profiles for priority countries
- Generate oil and gas profiles for the remainder non-priority countries and groups on a regional body of water basis (e.g. Black Sea, Caspian Sea, etc.)

Task 2

- Create a report that compares and contrasts regulations and policies for governing offshore oil and gas exploration and production

2.1 Scope

The scope of this report focuses mainly on Task 2, evaluating the offshore statutory and regulatory details of the priority countries identified by BSEE, and all tasks and sub-tasks in the statement of work[ii]. Although Task 1 can be considered a standalone deliverable, a brief summary of Task 1's findings and key highlights is included in the Appendix of this report in addition to the detailed listing of country and regional profiles attached as a separate files.

2.2 Approach and Methodology

Utilizing a list of countries, a systematic and efficient approach for both Task 1 and Task 2 was taken to generate a foundation of information that would provide the necessary input for identifying similarities, inconsistencies, and any incompatibilities across countries. In general, the methodological steps across Task 1 and Task 2 were:

- Create an analytical spreadsheet template as a repository for gathered information;
- Perform the necessary research and analysis to complete the analytical template for every priority country or regional grouping;
- Complete the accompanying word profile (applies only in Task 1);

[ii] A complete list of countries evaluated in addition to the *priority countries* can be found in the Appendix.

- Create and complete necessary comparing and contrasting figures or charts to highlight similarities and differences across Task 2 sub-tasks defined below:
    - Permitting;
    - Overseeing, monitoring, and requiring compliance with provisions on real time monitoring of offshore operations, equipment failure reporting systems, and accident near miss reporting;
    - Shallow vs. Deepwater permitting and monitoring of BOPs, cementing operations, and ROVs;
    - Oversight of drilling and production operations through an inspection program;
    - SEMS/SEMP regulations by phase of offshore activity;
- Organize and assemble the information across all priority countries and refine into the final report.

From these major components, the following sub-sections explain the detailed steps taken to complete the report:

Create an Analytical Spreadsheet

Both Task 1 and Task 2 utilized independent spreadsheet templates that mirrored the statement of work requirements. Examples of parameters analyzed were offshore geological and geophysical properties, methods of offshore tender, BOP requirements, whether offshore activity is regulated by SEMS/SEMP, and etc. The main difference between Task 1 and Task 2 was that Task 1 had two analytical spreadsheet templates – one for priority countries and the other for regional groupings, while Task 2 shared one unifying template for each priority country for comparing and contrasting against the key regulatory areas.

Research and Analysis

The ICF team collaborated while researching individual countries or regional groupings. Expert guidance from subject matter experts (SMEs) drove the identification and gathering of all pertinent information from publicly available and internal information to fill out the analytical spreadsheets. For countries without English legislation, ICF performed research in the country's native language and leveraged the international experience of SMEs for analysis. A detailed list of regulations reviewed and offshore regulators identified for each country can be found in the Appendix.

Complete the Word Profile

For Task 1, a stand-alone text document was created (referred to as a profile) for priority countries and regional groupings. The text profile drew upon information gathered in the analytical spreadsheet and SME input. A key piece of each text profile was a detailed overview of governing regulatory authorities, their regulatory charter, methods of interaction, cooperation and conflict, in addition to identification of regulatory authorities with similar responsibilities to BSEE in regulating offshore operations, where applicable.

Create and Complete Comparative Figures

To facilitate the comparison between various countries required of Task 2, multiple figures, diagrams and charts were created to aid in the discussion of key themes and findings. The intention was to allow quick comparison across all priority countries for easy identification of gaps and similarities.

Compile Final Report

Once the research and analysis were completed by ICF's investigative staff and SMEs, all Task 2 information was organized, assembled and refined into the final report. Task 1 has a brief summary found in the Appendix along with stand-alone deliverables as separate file attachments.

2.3 Definitions & Abbreviations

Term/Abbreviation	Definition/Meaning
ALARP	As low as reasonably practicable
ANP	National Petroleum Agency (Brazil) - Agência Nacional de Petróleo
API	American Petroleum Institute
BOEM	Bureau of Ocean Energy Management
BOP	Blowout preventer
BSEE	Bureau of Safety and Environmental Enforcement
CFR	Code of Federal Regulations
CNH	National Hydrocarbons Commission (Mexico)
C-NLOPB	Canada-Newfoundland and Labrador Offshore Petroleum Board
C-NSOPB	Canada-Nova Scotia Offshore Petroleum Board
DECC	Department of Energy and Climate Change (UK)
DP	Dynamic Positioning
HSE	Health and Safety Executive
ICP	Independent Competent Person
INC	Incident of Non-compliance
ISO	International Organization for Standardization
MWD	Measurement while Drilling
NEA	National Energy Authority (Iceland)
NEB	National Energy Board (Canada)
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority (Australia)
NORSOK	Norsk Sokkels Konkuranseposisjon
OCSLA	Outer Continental Shelf Lands Act
PCJ	Petroleum Corporation of Jamaica
PEMEX	Petróleos Mexicanos (state-owned oil and gas company)
PINC	Potential Incident of Non-compliance
PS	Performance Standard
PSA	Petroleum Safety Authority (Norway)
PVDSA	Petróleos de Venezuela, S.A. (state -owned oil and gas company)
ROV	Remotely Operated Vehicle
RP	Recommended Practice
RTM	Real Time Monitoring
SCE	Safety Critical Element
SEMS	Safety and Environmental Management System
SHE	Safety, Health, and Environmental
SME	Subject Matter Expert

WEA	Working Environment Authority (Denmark)
WOMP	Well Operations Management Plan

Country Abbreviations[iii]

Abbreviation	Country Name
US	United States
UK	United Kingdom
NO	Norway
CA	Canada
MX	Mexico
DK	Denmark / Greenland[iv]
IS	Iceland
AU	Australia
RU	Russia
VE	Venezuela
CU	Cuba
NZ	New Zealand
TT	Trinidad and Tobago
NL	The Netherlands
BR	Brazil
JM	Jamaica
BS	The Bahamas

[iii] These abbreviations are used to reference priority countries in subsequent Tables and Figures throughout this report.

[iv] Note that Denmark also includes Greenland. These countries were grouped together per the SOW for the project and described separately in this report's content, to reflect different offshore regulatory regimes.

3 Regulations and Regulatory Approaches

For most priority countries, there exists a statutory framework for the regulation of offshore activities. Across the spectrum of countries analyzed, some countries have a consistent and solid approach to safety, health, and environmental (SHE) regulations (e.g. Norway, United Kingdom, United States, Australia, etc.) while other countries have room for improvement or lack of a coordinated regulatory approach (e.g., Venezuela, Cuba, Jamaica, the Bahamas, etc.). Regardless, overall themes in terms of regulations and regulatory approaches are explored across all countries, and where applicable this report compares and contrasts the themes, approaches, and other aspects of regulatory requirements across criteria relevant to the project.

3.1 Country Regulatory Approaches

There are generally two main approaches in the regulation of offshore oil & gas operations:

- Prescriptive
- Performance-based

In prescriptive regulatory frameworks, offshore regulatory bodies set specific technical, behavioral, procedures, or processes which operators must adhere to. For example, a regulatory body may require a specific BOP design criterion. In contrast, performance-based regimes set operational goals or targets based on the minimization of SHE risks, allowing operators flexibility in determining what specific measures or equipment should be taken or used to achieve the desired outcome. While some country regulations are primarily prescriptive or performance-based, other countries include aspects of both systems. For the purposes of this report, these countries will be referred to as "hybrid" regulatory regimes. Norway is an example of hybrid regulatory regime as defined by this report. While most industry experts will agree that Norway is predominantly performance-based in their regulatory approach, there does exist a high number of supplementary prescriptive requirements that truly makes their approach a blend of both regimes.

In addition to having either a mainly prescriptive vs. mainly performance-based regime, priority countries can also be analyzed by maturity. Maturity describes the overall length of time a priority country has gained experience across the multiple phases of offshore operations in addition to the more traditional activities of a regulating entity (e.g., enforcement, issuing notifications of non-compliance, investigating a major SHE event). The effectiveness of a regulating entity is determined not only by the countries overall experience but also by the experiences of individuals operating within the regulating bodies themselves.

Examples of countries with performance-based regulatory approaches include the UK and Australia. In the case of the UK, the country's health and safety legislation has progressively changed since 1975 from prescriptive to a goal-setting basis[v]. The Piper Alpha disaster (1988,

[v] Driven mostly by significant HSE events that occurred during that time.

167 fatalities) and the subsequent Public Inquiry led by Lord Cullen was a defining event which spurred further changes in the UK regulatory framework. Lord Cullen's analysis and recommendations in his report have been very influential for other major hazard sectors as well as globally for the offshore sector. Three key changes that resulted were:

- Separation of the licensing/tax and health & safety responsibilities, with the latter transferred to HSE, already responsible for onshore major hazards, via a safety case regime. (The 'safety case' approach was developed initially in UK alone in late 1970s, and then by the subsequent 1982 EU Seveso Directive, which has since been twice updated).
- Extension of the safety case approach (a.k.a. 'permissioning regime') to cover all offshore installations, fixed and mobile, with goal-setting subsidiary legislation under the Health and Safety at Work Act 1974 (HSWA) to replace the previous prescriptive marine-based legislation developed and enforced by Dept. of Energy.
- Mandatory election and involvement of worker safety representatives, which had been strongly respected by the offshore employers sector prior to Piper Alpha. These arrangements cover all persons on offshore installations and not just union members, as was the case for the previously existing UK onshore legislation.

Most of the current health and safety legislation in the United Kingdom is now linked to European Union Directives. A primary regulation in the United Kingdom, with subsidiary regulations for petroleum operations, is the HSWA. A key concept in the Act is duty holders must ensure workplace hazards are identified, risks are assessed and controls are in place so that residual risks are as low as reasonably practicable (ALARP), i.e., the necessary effort (time, resources, and finances) to implement further controls would not be out of proportion to the resulting reduction of risk. As discussed above, Norway is defined closer to a hybrid regulatory approach, with mainly performance-based standards supplemented by prescriptive requirements.

A primary example of a performance-based approach is the use of a safety case in regulation of offshore operations at an installation. Safety cases were first developed in the United Kingdom in the 1970s. Safety cases are documents submitted to regulators demonstrating that a duty holder[vi] has in place suitable technical and management standards/practices to ensure risks from both major hazards and all other hazards are ALARP. As described in the United Kingdom Offshore Installations (Safety Case) Regulations, "safety cases are intended to be living documents, kept up to date and revised as necessary during the operational life of the installation. The duty holder must revise an accepted safety case whenever appropriate to ensure the case remains current and reflects operational reality at the installation[vii]".

[vi] International Association of Drilling Contractors (IADC). Duty holder definition: the operator in the case of a fixed installation (including fixed production and storage units); and the owner in the case of a mobile installation

[vii] UK Offshore Installations (Safety Case) Regulations available for download at this link: http://www.hse.gov.uk/pubns/books/l30.htm

In contrast, United States regulations are more prescriptive in nature, in that administrative regulations are primarily written to instruct operators what actions or equipment specifications must be followed. Prescriptive standards are often based on industry standards (e.g. American Petroleum Institute – API in the United States) which have been developed from industry experience in equipment and personnel failures/accidents in the industry both domestically and internationally. Prescriptive regulations are intended to ensure that complying with regulatory standards will prevent negative health, safety, or environmental consequences, though give operators less flexibility, as compared to performance-based standards, in achieving those outcomes. Prescriptive regulations often do not allow operators to easily or quickly take advantage of new technology or practices. Figure 1 below depicts categorizations of priority countries analyzed in this report according to the degree of performance-based, prescriptive, or hybrid regulatory approaches against maturity.

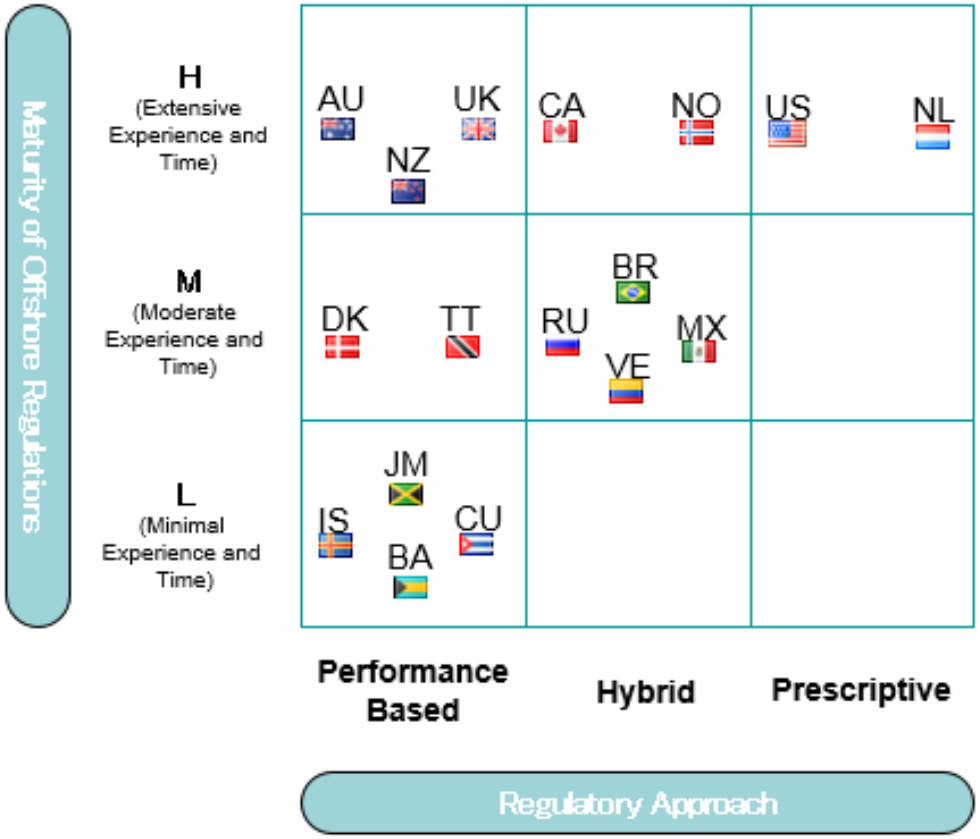

Figure 1 – Regulatory Approach vs. Maturity of Offshore Regulations for Priority Countries

Countries with Little to No Offshore Production

Countries without offshore production operations, e.g., Jamaica and Bahamas have the least hydrocarbon SHE regulations in place when compared to other priority countries. In Jamaica, the primary hydrocarbon legislation is the Petroleum Act of 1979, which establishes the state-owned Petroleum Corporation of Jamaica (PCJ) and provides broad performance-based specifications

for SHE regulation of the offshore sector. Jamaica is currently updating its petroleum regulations and has two bills, the Petroleum (Quality Control) Bill and the Petroleum (Quality Control), in progress. Regulations are being considered/approved by the Legislation Committee "to provide for regulation of the petroleum sector as it relates to petroleum safety[3]." In the Bahamas there have been not been any offshore drilling operations for roughly the past 30 years, and the government is in the process of updating its petroleum regulations. The main current petroleum regulations in the Bahamas are the Petroleum Act of 1971 and the Petroleum Regulations of 1978 (both amended in 1987 and 1994). The Ministry of Environment and Housing is to release a new Petroleum Act and a suite of new regulations to manage future oil exploration operations in the country. The new Act and regulations will address permitting, as well as health, safety, and environment concerns associated with upstream hydrocarbon activities.

In comparison, Iceland and Greenland have developed regulatory frameworks to permit and monitor offshore activities. In Iceland, the offshore regulator the National Energy Authority issues performance-based guidelines for safe offshore operations. As an indication, Article 13 of Iceland's Act 13: On Prospecting, Exploration, and Production of Hydrocarbons (October 14, 2014) states, "When exploring for and producing hydrocarbons, every measure of safety shall be taken, and the activity shall be in accordance with good international practice for similar situations. The activity shall not needlessly endanger or hinder communication, fisheries or other activities[4]." Additionally, as outlined in regulations, exploration and production licenses as well as field development and production plans contain provisions for oversight and enforcement of health, safety, and environmental conditions. Technical/operational items requested in Field Development and Production Plans submitted by operators to the National Energy Authority (outlined in Article 27 of Regulation Number 884: On Prospecting, Exploration and Production of Hydrocarbons) include "description of technical arrangements for emergency preparedness (item n) and other information that is required according to the safety and security legislation valid at any given time (item o)." In Greenland, offshore operations are regulated by the Bureau of Minerals and Petroleum, who prescribes performance-based and prescriptive technical/operational requirements. Overall, all drilling operations are to be performed in accordance with NORSOK Standard D-010: "Well Integrity in Drilling and Well Operations."

3.2 Country Statutory and Regulatory Requirements

Individual country offshore regulatory requirements are primarily found in published country statutory regulations and published guidance documents. Statutory and regulatory requirements for countries analyzed in this report are in the following major categories:

- General offshore operations;
- Offshore operations permitting;
- Regulatory oversight , monitoring, and compliance on real time monitoring of:
  - Offshore operations;
  - Equipment failure reporting systems and;
  - Accident near miss reporting.
- Deep vs. shallow water permitting and monitoring of :
  - Blowout preventer system requirements (subsea vs. surface);

  - Cementing operations and
  - Remotely operated vehicles requirements.
- Drilling and production operations inspection programs and;
- Safety management system requirements (SEMS/SEMP).

A summary table can be found in the appendix detailing the regulating entities and requirements review and analyzed for every priority country.

3.3 Comparing and Contrasting Regulatory Polices and Approaches

Every subsequent section presents a detailed look into the specific areas set forth in the report, whether it is permitting or analyzing inspection programs. Each individual section provides an overall coverage or applicability chart in addition to a qualitative/quantitative analysis of each countries regulatory policies for the specific area of interest. In general, the criteria 'Quality of Enforcement' refers to what actually happens between individual inspectors or inspection groups and the duty holder or operator. While the criteria 'Quality of Enforcer' refers to systems that are publicly available as to whether the regulations are well organized and make use of latest concepts. Sometimes the latter is referred to as top end management of the enforcer.

The purpose of this section is to summarize and offer a composite view of these various sub-tasks, highlighting key areas of contrast (i.e. similarities and inconsistencies). The summary in Table 1 provides the qualitative and quantitative color-coded composite ranking of priority countries based on how each country was evaluated in subsequent sections. In the individual sub-task sections, general criteria (e.g. quality of enforcement/enforcer) and specific criteria relevant to the sub-task (e.g. Do guidance documents exist?) were used to determine rankings. Input from industry SMEs in addition to research were used to provide the basis for comparing and contrasting each priority country. Qualitative Harvey Balls are used from a full ball (i.e. high quality) to a quarter ball (i.e. lower quality) where an empty ball indicates nothing is in place in the regulations.

Table 1 – Overall Summary of Results for Comparing and Contrasting Priority Countries with Respect to Key Statement of Work Criteria

Requirement \ Country	US	UK	NO	CA	MX	DK	IS	AU	RU	VE	CU	NZ	TT	NL	BR	JM	BS
Overall Country Ranking	6	2	1	4	11	8	10	3	12	14	15	5	13	7	9	16	17
1) Permitting Activities	◑	●	●	◑	◔	◑	◔	●	◔	◔	◔	◑	◑	◑	◔	◔	◔
2) Real Time Monitoring of Offshore Operations, Equipment Failure Systems, and Accident Near Miss Reporting	◔	●	●	◔	○	○	◔	◔	○	○	○	◔	◔	◔	◔	◔	○
3) Shallow vs. Deepwater Requirements for BOPs, Cementing, and ROVs	◑	●	●	●	◑	◔	◑	●	◑	◔	◔	◑	◔	◑	◑	◔	◔
4) Drilling and Production Activities Inspection Program	◑	●	●	◑	◔	◑	◔	●	◔	◔	◔	◑	◔	●	◑	◔	◔
5) Phases of Offshore Activity Regulated by use of a Safety Management Systems (SEMS, SEMP, etc.)	◑	●	●	◑	◔	◑	◔	●	○	◔	◔	◑	◔	◑	◑	◔	◔

Legend

●	High Level of Quality	◔	Low Level of Quality
◑	Medium Level of Quality	○	Nothing in Place

4 Permitting Activities

The method and extent to which priority country offshore regulatory authorities permit the lifecycle of offshore petroleum activities varies according to phase of operation, which are defined as follows:

- Exploration
- Drilling
- Development
- Production
- Well Completion
- Well Work Over
- Well Abandonment
- Facility Decommissioning

In traditional permit systems, regulated entities (operators) submit information requested by regulatory authorities to receive authorization (typically a physical document) to perform certain activities in a particular operations phase. The United States predominately follows this approach and permits are required throughout the lifecycle of offshore operations, including for example, prior to drilling & modifying a well and abandoning & decommissioning an offshore platform. Outside the United States, permit programs introduce risk identification and analysis as opposed to traditional permitting regimes, which typically involve completion, submission, and approval of standardized documents/forms.

When characterizing other permitting systems, several forms of permitting are used across priority countries, Examples of non-traditional permitting approaches include the risk assessment/safety case method and the plan-based method. Descriptions of these two alternative permitting approaches are provided below.

Risk Assessment/Safety Case Method

- Under the risk assessment/safety case approach, an applicant (operator) submits a safety case, which is a document whose purpose is to fully describe to the regulator that the operator has analyzed and has the means in place to control all major accidents to a level of risk as low as reasonably practical (ALARP). Once a safety case is approved, an installation is approved ("permitted") as a whole and operators are understood as having general permission, with a few exceptions, to perform all necessary activities for petroleum exploration & development/production across the phases of operations relevant for that installation.

Plan Based Method

- A plan-based permitting approach involves submission of documents or plans describing one or multiple phases of offshore operations to be performed at a facility to regulatory agencies. Regulatory agencies may specify which phases of offshore operations require plans as well as what standards or guidelines the plans should include. Operational plans are subsequently reviewed and either approved by regulatory agencies or denied/returned for improvements. Once an operator's plan is approved, an operator is in general permitted to perform all activities associated with the accepted operation.

Plan and Safety Case Method Comparison

Based on the criteria of ease of operator implementation and personnel training, plan-based permitting is considered more streamlined when compared to a safety case permitting approach. Plan-based approaches are more prescriptive than safety case permitting approaches, based on compliance with regulatory operations and equipment standards, whereas safety-case approaches place a much greater emphasis on systemic operator identification and implementation of site-specific performance standards (e.g. for a particular operation or piece of equipment). In this regard, safety case approaches may be more time consuming, depending on the complexity of the facility and/or subsea and metocean conditions at the offshore location.

In terms of hazard/risk identification and management, the safety case regime is generally considered to be a more comprehensive approach over the lifetime of a facility[viii]. The safety case serves as a 'living' document of offshore operations at a facility, which facilitates long term communication towards addressing SHE concerns at a facility between an operators and regulator regarding current/proposed activities. This contrasts with a more plan-based method involving separate permitting of each activity (e.g. drilling a well) prior to its occurrence, which may not foster an understanding on the behalf of the regulator as of how the activity fits into the entire performance-based SHE goals of the facility. Safety case approval, as opposed to individual activity approvals, is the major effort for an offshore regulator, and as is the case in the UK, a safety case is required to be updated at least every five years or prior to any "material change", while a facility is in operation. While a safety case approach may not be faster than a plan-based approach in the initial approval of an offshore facility's operations, over the course of a facilities lifetime, it may result in a lesser level of prescriptive compliance measures by an operator, and consequently less document review by a regulator.

Additionally, while there are no known formal investigations into which permitting approach may result in less offshore accident/incompliance events, the International Association of Oil and Gas Producers (OGP) compiles a cumulative report of data for both onshore and offshore oil/gas health performance indicators, available for review publicly[5]. The data relies on voluntary reporting from individual operators. The OGP Safety Performance Indicators Report characterizes two safety indicators by both region and country/country: fatal accident rate (FAR) and total recordable injury rate (TRIR). Towards comparison of permitting regimes, vis-à-vis safety vs. plan-based, based on review of information presented in the 2013 report, there are no significant performance differences between the United States (plan-based permitting regime) and the UK and Australia[ix] (both safety case regimes) in terms of the five year average FAR, which for each country was approximately 2.5 fatal accidents per million hours worked. With respect to TRIR (per million hours worked), country values for these countries, in decreasing order are: Australia (approx. 4.4), the United States (approximately 3.2), and the United Kingdom (approx. 2.8).

The UK approach also supplements the safety case approach with a notification procedure for specific offshore activities, including drilling, or downhole changes to a well. As part of this

[viii] It is important to note that plans submitted under a plan-based approach can also be both risk-based and life-cycle based.

[ix] Australia does have plan submittal requirements as part of the permitting regime.

notification procedure, operators must inform the regulatory entities prior to performing certain operations (e.g. moving a drilling installation or beginning combined operations involving two or more installations in close proximity) and the regulatory authorities have a 10-21 day window to enforce/prevent performance of the requested operation(s).

Countries with predominately plan-based permitting approaches include Australia, New Zealand, and Norway. In comparison, the United States has individual permits along with some elements of plan-based permitting are used in the regulation of the phases of offshore operations. Other priority countries either have limited statutory requirements for permitting of offshore operations (e.g. Bahamas, due to lack of offshore activity) or follow different permitting procedures (e.g. safety case and plan-based regimes).

Internationally, several regulatory agencies permit offshore operations at an installation as a whole (e.g. Department of Energy and Climate Change – DECC/Health and Safety Executive – HSE with the Safety Case approach in the United Kingdom) and in some cases operators are even left to self-develop and self-enforce safety standards for offshore operators (in the case of the national oil company PEMEX in Mexico).

Table 2 below provides a coverage overview of what phases of offshore activity are permitted according to priority country regulatory documents. Countries like the United States explicitly require in their regulations permits for each phase of offshore operations, while other countries such as the United Kingdom do not have such prescriptive requirements[x]. Rather, the UK regulation implicitly requires permitting of specific offshore phases through the implementation of safety cases. Open circles in the table indicate no coverage, neither through prescriptive or performance based means.

[x] A safety case approach does not mean that there is the complete absence of prescriptive requirements. Part of the safety case is for the applicant to demonstrate that the operation will comply with technical standards. The contrast of the U.K. and the U.S. is that in the U.S. approach *everything* is a prescriptive requirement

Table 3 provides a qualitative and color-coded quantitative ranking of priority countries with respect to general criteria (e.g. quality of enforcement/enforcer) and specific criteria relevant to permitting (e.g. Do guidance documents exist?). Input from industry SMEs in addition to research were used to provide the basis for comparing and contrasting each priority country. Qualitative Harvey Balls are used from a full ball (i.e. high quality) to a quarter ball (i.e. lower quality) where an empty ball indicates nothing is in place in the regulations.

Priority country details with respect to permitting follow the tables and provide a much closer look at the specific nuances and variations exhibited.

Table 2 – Overview of Permitting Activities for Phases of Offshore Activity

Country / Requirement	US	UK	NO	CA	MX	DK	IS	AU	RU	VE	CU	NZ	TT	NL	BR	JM	BS
Permitting Activities																	
Exploration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Drilling	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	○	✓
Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	○	✓	✓	✓	✓	○	✓
Production	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	○	✓	✓	✓	✓	○	✓
Well Completion	✓	✓	✓	✓	○	✓	○	✓	✓	○	○	✓	✓	✓	✓	○	○
Well Work Over	✓	✓	✓	✓	○	✓	○	✓	✓	○	○	✓	✓	✓	✓	○	○
Well Abandonment	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	○	✓
Facility Decommissioning	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	○	✓

Legend

✓	Covered in regulations
○	Not covered in regulations

Table 3 – Assessment of Permitting Activities across Priority Countries

Country / Requirement	US	UK	NO	CA	MX	DK	IS	AU	RU	VE	CU	NZ	TT	NL	BR	JM	BS
Permitting Activities																	
Country Ranking	8	2	1	4	11	5	14	3	13	12	15	7	9	6	10	16	17
Quality of Enforcement	◑	●	●	◑	◔	◑	◑	●	◔	◔	◔	◑	◑	◑	◔	◔	◔
Quality of Enforcer	◑	●	●	●	◔	◔	◔	●	◔	◔	◔	◑	◑	◑	◔	◔	◔
HSE Regulator Involved in Pre-Licensing Assessments	◑	●	●	◑	◔	◑	◑	●	◔	◔	◔	◑	◑	◑	◑	○	○
Requests for Changes to Existing Permits Assessed in Detail	◑	●	●	◑	◔	◑	○	●	◔	◔	◔	◔	◔	◔	◔	○	○
Regulator Guidance Documents Exist	◔	●	●	◔	◔	◑	○	●	○	○	○	◔	○	◑	○	○	○

Legend

●	High Level of Quality	◔	Low Level of Quality
◑	Medium Level of Quality	○	Nothing in Place

Australia – The Australia offshore regulatory body, the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), requires submission of a safety case, a Well Operations Management Plan (WOMP), and operation-specific licenses for permitting of offshore activities. NOPSEMA states that an offshore facility cannot be constructed, installed, operated, modified, or decommissioned without an approved safety case. A NOPSEMA-approved WOMP is a document which demonstrates there is a system in place to manage well integrity and well activities for the lifetime of a well. Examples of activities described in a WOMP include drilling, completion, re-completion, operation, testing, and abandonment/suspension of well operations. Licenses required for offshore operations include a petroleum exploration permit, an infrastructure license (to construct and operate a facility), and a production license.

Bahamas – There are fewer permitting procedures in place for offshore operations in the Bahamas when compared to other priority countries. There have been no offshore drilling operations in the Bahamas in the past 30 years and the government is in the process of updating its petroleum regulations. The current regulatory framework requires permits for exploration, drilling, development, and production operations.

Brazil – Offshore operations in Brazil are permitted under a multi-level licensing process coordinated by the Brazilian Institute for Environment and Renewable Natural Resources (Instituto Brasileiro de Meio Ambiente e dos Recursos Naturais Renováveis – IBAMA) which includes a preliminary drilling permit, a preliminary permit for production research, an installation permit, and a production operations permit. Some operations (e.g. well completion and well workover operations) are not separately permitted even though they are considered approved following review/approval of an operator's Operational Safety Management System by the Brazilian National Agency of Petroleum, Natural Gas, and Biofuels (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis - ANP).

Canada – Well approvals are granted by either the Newfoundland-Labrador or Nova Scotia Offshore Petroleum Boards for offshore drilling, re-entering, work over operations, completion/re-completion, and abandonment/suspension operations. Certificates of Fitness for offshore installations are granted by the Offshore Petroleum Boards which indicate installations are "designed, constructed, transported, and installed" according to Canadian regulatory standards.

Cuba – The Cuban regulatory framework requires permits for the operation of any offshore drilling/exploration platform, as well as for the initiation of drilling operations. The procedure used to evaluate the competence of international companies interested in performing offshore oil and gas operations in the country is outlined in Regulation 299: "Procedure to Qualify International Companies Interested in Oil and Gas Exploration and Production in the Republic of Cuba."

Denmark – The Danish Working Environment Authority (WEA) issues permits and approvals for main phases of offshore operation which include: exploration, drilling, construction/alteration

of an existing offshore facility, and prior to dismantling a facility. Safety Cases play an important role in the Danish regulatory framework which "demonstrates that the duty holder has assessed the health and safety risks on the installation and reduced them to a level that is as low as reasonably practicable (ALARP) and also demonstrates that these risks are controlled through a health and safety management system[6]."

Greenland – the Bureau of Minerals and Petroleum (BMP) is responsible for approval and supervision of offshore drilling operations. All drilling activities by operators with exploration or production licenses require approval from the BMP. Operators are also required to obtain and provide to the BMP a certificate of fitness for a drilling installation and issued by recognized certifying authorities (i.e. American Bureau of Shipping, Bureau Veritas, Det Norske Veritas, or Lloyd's Register of Shipping). Before operating in Greenlandic waters, all drilling units must present a "valid and updated health and safety certificate." The BMP accepts the Norwegian Acknowledgement of Compliance (AoC) or the UK Safety Case to fulfill the requirement for an updated health and safety certificate.

Well abandonment is the only other permitting area strictly required by Greenland regulations.

Iceland – License/permits are required for several offshore activities and associated plans are submitted by operators to the offshore regulatory body, the National Energy Authority, for review and approval. The first two licenses for offshore exploration were issued in January 2013 but there has not been any offshore drilling or development to date. Operations which require approval include exploration (exploration license required), drilling (approved after acceptance of a field development and production plan), development (requires approved field development plan), and decommissioning operations.

Jamaica – There is no significant permitting of offshore operations in the Jamaican regulatory framework. Offshore exploration licenses are granted under production sharing agreements made between the Petroleum Corporation of Jamaica (their national oil company) and foreign oil companies.

Mexico – Exploration activities and drilling and development operations require permits in the Mexican regulatory framework issued by the National Hydrocarbons Commission.

Netherlands – In the Netherlands regulatory offshore regulatory framework, various work plans are submitted to the State Supervision of Mines for approval of specific phases of offshore operations; these include a 'work programme for construction of a borehole' prior to drilling operations and a '5-year work plan' prior to development and well completion/workover activities. Exploration and production operations are permitted through the issuance of licenses to operators. Well abandonment operations are permitted through the submission and approval of a work plan submitted to the State Supervision of Mines seven days prior to commencement of operations and facility decommissioning operations are similarly permitted, requiring eight weeks' notice.

New Zealand – An approved safety case is used to permit offshore operations. The safety case is valid for the lifetime of the installation although it needs to be revised every five years or prior to any material changes at an offshore facility (e.g. change in operations or management). There is no formal permitting process for specific phases of offshore operations (e.g. well workover/completion), though operators are required to notify the offshore regulatory body, WorkSafe, prior to commencement of well drilling, completion, workover, and abandonment operations.

Norway – The first step in the offshore permitting process is a pre-qualification procedure, operated jointly by the regulatory authorities, the Norwegian Petroleum Safety Authority (PSA) and the Norwegian Petroleum Directorate (NPD). The pre-qualification process assesses whether an applicant meets national offshore requirements (including health, safety, and environment expertise and capacity, incorporation of a safety management system, and financial stability). After passing the pre-qualification process, an operator is required to obtain 'consents' from the PSA at select operational stages. Consents are required prior to performing activities in select operational phases, including: drilling, development (major modifications or using a facility past its established operating life), manned under water operations (performed in conjunction with well workover activities), and prior to disposing/removing/moving a facility[7].

Russia – The Federal Agency for Subsoil Use (ROSNEDRA) issues production licenses for the right to use subsoil resources. There is no significant permitting of offshore operations in the Russian regulatory framework, but permission to perform exploration, drilling, development, production, and decommissioning activities are included in a production license. Permitting of well completion, workover, and abandonment operations is not addressed in the Russian regulatory framework.

Trinidad and Tobago – In general, all phases of offshore operations must receive a Certificate of Environmental Clearance (CEC) from the Environmental Management Authority (EMA). Permits must also be obtained from the Ministry of Energy prior to performance of select offshore operations, including: exploration, drilling, development, and decommissioning activities.

United Kingdom – After an operator receives approval to operate offshore[8], offshore activities are permitted through a combined use of a safety case and a notification process. Once a safety case is approved, the Department of Energy and Climate Change/Health and Safety Executive (HSE) issues a letter of 'non-objection' which gives an operator a "green light" to engage in offshore operations, even though additional notifications are required prior to performance of specific offshore activities. The HSE states "the purpose of a notification is to inform HSE of the forthcoming operation and demonstrate that the planned operation will be carried out safely. It should contain sufficient information for the inspector reviewing the notification to understand the nature of the operation and satisfy them that the risks to health and safety specific to the well have been identified and suitable precautions are implemented[9]." Operators do not receive traditional consent (permission) to perform specific activities following submission of a notification to the offshore regulatory. Instead, if after the 10-21 day notification period no

enforcement action has been taken by the regulator to prevent the operator from performing offshore activities, operations may commence and operators are henceforth responsible for the safety of the well. A safety case is to be revised at least every five years or prior to any proposed "material change" at an installation and re-submitted to the HSE, who may either accept or require further clarification regarding the proposal(s).

United States – The U.S. employs a traditional permitting process where consent is required by the offshore regulator for an operator to perform specific activities throughout the lifecycle of offshore operations. In additions to permit applications, operators are required to submit several plans describing anticipated offshore operations to regulators. The lifecycle of offshore operations (exploration, drilling, development, well completion, well workover, well abandonment, and well decommissioning) are permitted by regulatory authorities in the country.

Venezuela – An offshore license granted by the Venezuelan Ministry of Energy and Mining confers exploration and production rights to an operator. Offshore activities which require consent include suspension of drilling operations, development operations, and well abandonment/facility decommissioning. Development operations are approved and permitted by the Ministry of Energy and Petroleum, following submission of a development plan which contains the financial and technical details of the project.

5 Safety Management Systems

Overview

This section compares the safety management system statutory/regulatory requirements across upstream offshore operations for all priority countries. Overall, 10 of the 17 priority countries (Australia, Brazil, Canada, Cuba, Denmark/Greenland, Netherlands, New Zealand, Norway, the United Kingdom, and the United States) have some form of Safety/Environmental Management System requirements governing all upstream offshore operations. Remaining priority countries have little or no requirements with respect to SEMS/SEMP.

In general, a management system refers to a system of processes which guarantees that an organization/company fulfills all steps required to meet its objectives. In the realm of offshore SHE regulation, safety/environment management systems, as the title indicates, are designed to improve the safety of offshore installations and reduce risks to people and the natural environment. To accomplish this, safety management system models apply to all activities at an installation based on principles including identification of policies and objectives, adherence to standards/regulations, identification of hazards, personnel training, controls and risks, and processes for continual improvement, including monitoring, auditing, and corrective actions. All priority countries that require SEMS perform external auditing to ensure operator compliance. Internal auditing (third or second party), is also required for all performance-based regimes which have SEMS requirements. Experience is that for a specific organization, combining the insights, findings and results from internal and external auditors, has led to identifying opportunities for improving how the documented SEMS is actually applied.

Prescriptive vs. Performance-based Regulation

Across international offshore operations, safety management system regulatory requirements may be guided by prescriptive-based or performance-based principles. Prescriptive-based safety management systems regulations may require a checklist of procedures for operators to incorporate into their offshore operations/practices, whereas performance-based systems specify health, safety, and environmental goals and operators have more flexibility in deciding how the safety management system will achieve those goals. Both prescriptive and performance-based standards are considered to be required for an effective offshore SEMS. At its core, an effective SEMS serves as the basis for major accident/incident prevention for all employees of an organization, from the board level to the frontline personnel and contractors on a platform. In this regard, a successful SEMS must effectively communicate prescriptive operating procedures in certain circumstances/time periods, as well as performance based standards, such as the element of continual improvement of management systems based on experiences at a particular installation, or elsewhere as part of a company's operations. The most effective SEMS emphasize safety above other consideration, including the potential for of loss of hydrocarbon production, in order to address perceived/identified major hazards at a particular facility.

Management System Standards

Regulatory/Statutory requirements often incorporate elements of management system standards published by industrial and standardization organizations. For example, the United States Code of Federal Regulations (CFR) Title 30, Subpart S, Safety and Environmental Management Systems (SEMS) references the American Petroleum Institute's Recommended Practice 75 (API RP 75): Development of a Safety and Environmental Management Program for Offshore Operations and Facilities. In the case of the United States, the API RP 75 standard is prescriptive in nature, with a direct application for offshore operations. Internationally, safety/environmental management system standards define generic goals for occupational health, safety and environmental impacts which offshore oil companies/operators apply to offshore petroleum operations. Some example standards include ISO 14001 (Environmental Management Systems) and OHSAS 18001 (Occupational Health and Safety Management). Common international safety management system elements considered include facility design and construction, management of change and/or contractors, leadership responsibilities, environmental/hazardous waste management, and emergency/incident preparedness and response processes. Alternatively, countries may publish their own safety management systems standards/guidelines, as in the case of Australia and New Zealand (AS/NZS 4804:2001), as well as Brazil. In general an internationally constructed and recognized SEMS standard would work best in most cases since countries that have their own SEMS standards typically reference API or ISO documents. Thus, there is little difference between the two.

Currently, there is no recognized international SEMS Standard for the offshore sector (API RP75 has few advocates outside USA). IOGP has published an Operating System Management Framework (report no. 510, June 2014) for the global oil and gas sector, upstream and downstream plus implementation guidance OMS in Practice (report no. 511, same date), both of which are very suitable to apply as a SEMS model for offshore activities. OHSAS 18001, mentioned above, is actually a UK document, though widely used international and something of a *de facto* international standard. However it is due to be replaced in 2016 by ISO 45001 (currently nearing final draft status) which is structured very similarly to ISO 18001. Once ISO 45001 is published it is very likely that countries such as U.S., New Zealand and Australia that have developed and issued national OHSMS standards, and in some cases linked them to regulatory requirements, will need to decide whether to withdraw their national standards, or fully revise them to align with the ISO versions.

Offshore Safety Management System Regulatory Compliance

For priority countries with established offshore regulatory frameworks, safety management systems are generally required to be fully implemented at an installation prior to commencement of operations. Some countries require a full regulatory review of safety management systems (e.g. Brazil) while others simply require safety management systems to be in place with little oversight/monitoring on the part of regulatory agencies (e.g. United States). In the case of priority countries who are European Union member states (Denmark, Netherlands, and the United Kingdom), the 2013 European Directive titled "on safety of offshore oil and gas operations," requires operators to submit to regulatory bodies copies of the safety and environmental management system for an installation. Article 19(3) states that a safety and

environmental management system shall include "a description of (a) organizational arrangements for control of major hazards; (b) arrangements for preparing and submitting reports on major hazards, and other documents as appropriate, pursuant to this Directive; and (c) schemes for independent verification[xi]."

Table 4 below provides a coverage overview of what phases of offshore activity have SEMS/SEMP requirements according to priority country regulatory documents. Checks indicate coverage of the topic in country statutory/regulatory provisions, while circles indicate no/very limited coverage of the topic.

[xi] Independent Verification is described in Article 17 of the EU Directive 2013/30/EU. An example of an operation for independent verification cited in the Directive includes "independent assurance that well design and well control measures are suitable for the anticipated well conditions at all times."

Table 5 provides a qualitative and color-coded quantitative ranking of priority countries with respect to general criteria (e.g. quality of enforcement/enforcer) and specific criteria relevant to SEMS/SEMP (e.g. Fully integrated for major hazards?). Input from industry SMEs in addition to research were used to provide the basis for comparing and contrasting each priority country. Qualitative Harvey Balls are used from a full ball (i.e. high quality) to a quarter ball (i.e. lower quality) where an empty ball indicates nothing is in place in the regulations. The criteria 'Fully integrated for major hazards' refers to if the SEMS requirement takes into account major hazards or just typical occupational hazards.

Table 6 provides a detailed description of safety management systems across priority countries, country-specific nomenclature, and whether there is a general SMS requirement.

Table 4- Overview of Safety Management Systems for Phases of Offshore Activity

Country / Requirement	US	UK	NO	CA	MX	DK	IS	AU	RU	VE	CU	NZ	TT	NL	BR	JM	BS
SEMS/SEMP by Phase																	
Exploration	✓	✓	✓	✓	○	✓	✓	✓	○	○	✓	✓	○	○	✓	○	○
Drilling	✓	✓	✓	✓	○	✓	✓	✓	○	○	✓	✓	○	○	✓	○	○
Development	✓	✓	✓	✓	○	✓	✓	✓	○	○	○	✓	○	○	✓	○	○
Production	✓	✓	✓	✓	○	✓	✓	✓	○	○	○	✓	○	○	✓	○	○
Well Completion	✓	✓	✓	✓	○	✓	✓	✓	○	○	○	✓	○	○	✓	○	○
Well Work Over	✓	✓	✓	✓	○	✓	✓	✓	○	○	○	✓	○	○	✓	○	○
Well Abandonment	✓	✓	✓	✓	○	✓	✓	✓	○	○	○	✓	○	○	✓	○	○
Facility Decommissioning	✓	✓	✓	✓	○	✓	✓	✓	○	○	○	✓	○	○	✓	○	○

Legend

✓	Covered in regulations
○	Not covered in regulations

Table 5 - Assessment of Safety Management Systems across Priority Countries

Country / Requirement	US	UK	NO	CA	MX	DK	IS	AU	RU	VE	CU	NZ	TT	NL	BR	JM	BS
SEMS/SEMP																	
Country Ranking	6	3	1	8	14	7	11	2	14	13	12	4	10	5	9	16	17
Quality of Enforcement	◔	◑	◑	◔	○	◔	◔	◑	○	○	○	◑	◔	◔	◑	○	○
Quality of Enforcer	◔	◑	◑	◔	○	◔	◔	◑	○	○	○	◑	◔	◔	◑	○	○
Fully integrated for major hazards	◑	●	●	◑	○	◑	○	●	○	○	○	◑	○	●	○	○	○

Legend

● High Level of Quality	◔ Low Level of Quality
◑ Medium Level of Quality	○ Nothing in Place

Table 6 – Description of Country Offshore SHE Management System/Program Requirements

Country	Statutory/regulatory SMS requirement?	SMS nomenclature	SMS required across all operations?	SMS Description/Scope (phases of offshore activity regulated)
Australia	✓	Safety Management System	✓	▪ A safety management system covering the lifecycle of operations at installation is included in safety cases submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). ▪ As stated in the Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009, Part 2, Article 2.5 (3): "The safety case for a facility must contain a safety management system that o Is comprehensive and integrated; o Provides for all activities that will, or are likely to, take place at, or in connection with, the facility; o Provides for the continual and systematic identification of hazards to health and safety of persons at or near the facility…[10]"
Bahamas	✗	n/a	n/a	No statutory/regulatory SMS system requirement in place.
Brazil	✓	Operational Safety Management System	✓	▪ A safety management system covering the lifecycle of offshore operations is required according to Regulation Number 43/2007, established by the National Petroleum Agency. Safety Management Systems must address 17 management practices: 1. Culture of Safety; 2. Involvement of personnel; 3. Personnel qualification, training, and

Country	Statutory/regulatory SMS requirement?	SMS nomenclature	SMS required across all operations?	SMS Description/Scope (phases of offshore activity regulated)
				performance; 4. Work environment and human factors; 5. Selection, control and management of contractors; 6. Monitoring and continuous performance improvement; 7. Audits; 8. Management of information and documentation; 9. Incident investigation; 10. Design, construction, installation, and decommissioning; 11. Critical operational safety elements; 12. Risk identification and analysis; 13. Mechanical integrity; 14. Planning and management of major emergencies; 15. Operational procedures; 16. Management of change (MOC); 17. Safe working practices and control procedures in special activities.
Canada	✓	Management System	✓	▪ Management system is required for all operators applying for drilling/production operations, as prescribed in the Canada Oil and Gas Drilling and Production Regulations.

Country	Statutory/regulatory SMS requirement?	SMS nomenclature	SMS required across all operations?	SMS Description/Scope (phases of offshore activity regulated)
Cuba	✓	Safety Management System	Drilling operations	▪ Management system is required for all drilling contractors with operations in the country to be submitted to the Office of Environmental and Nuclear Safety Regulation. System must contain: ▪ Description of the drilling contractor policies and objectives, organization, responsibilities,
Denmark / Greenland	✓	Health and Safety Management System (Denmark)	✓	▪ In Denmark, a health and safety management system "based on recognized norms and standards for management systems or similar systems shall be established before operation of the installation is commenced[11]," as stated in the Offshore Safety Act, which is administered by the offshore regulator, the Working Environment Agency. ▪ In addition, as a European Union member state, copies of the Safety and Environmental Management System for an installation are to be submitted to a country's offshore regulators to ensure that a system is in place, according to the 2013 EU Directive: "on safety of offshore oil and gas operations." ▪ In Greenland, operators are required to demonstrate that they have a Safety Management System in place to offshore regulator, the Bureau of Minerals and Petroleum (BMP).
Iceland	✗	n/a	n/a	No statutory/regulatory Safety Management System requirements in place. Work plans are submitted to the offshore regulator, the National Energy Authority, for approval of certain offshore activities.
Jamaica	✗	n/a	n/a	No statutory/regulatory Safety Management System

Country	Statutory/regulatory SMS requirement?	SMS nomenclature	SMS required across all operations?	SMS Description/Scope (phases of offshore activity regulated)
				requirements in place.
Mexico	✓	Safety, Health, and Environmental Management Systems	n/a	▪ There is currently no strict requirement for offshore safety management systems. The National Hydrocarbons Commission (CNH) requests the "implementation level of safety, health, and environmental management systems[12]" be submitted along with implementation plans for exploration and production/development plans by PEMEX, the national oil company. ▪ The newly-created petroleum sector regulatory body, the National Agency for Industrial Safety and Environmental Protection, has authority to create a management system covering the lifecycle of offshore operations; elements covered by a future management system are covered in Articles 12-21 of the federal law establishing the agency.
Netherlands	✗	*Safety and Environmental Management System	✓	▪ As a European Union member state, copies of the Safety and Environmental Management System for an installation are to be submitted to a country's offshore regulators to ensure a system is in place, according to the 2013 EU Directive: "on safety of offshore oil and gas operations." ▪ Currently, no statutory/regulatory Safety Management System requirements are located in the country's offshore statutory/regulatory framework.
New Zealand	✓	Safety Management System	✓	▪ Required safety management system across offshore operations "to assure the safe operation of an installation through the effective management of hazards, including major accident hazards[13]."

Country	Statutory/regulatory SMS requirement?	SMS nomenclature	SMS required across all operations?	SMS Description/Scope (phases of offshore activity regulated)
Norway	✓	Health, Safety, and Environmental Management System	✓	▪ A health, safety, and environmental management system is required for each operating facility. The management system must be regularly reviewed internally and audited.
Russia	✗	n/a	n/a	No statutory/regulatory Safety Management System (SMS) requirements in place.
Trinidad and Tobago	✗	n/a	n/a	No statutory/regulatory Safety Management System (SMS) requirements in place.
United Kingdom	✓	Safety and Environmental Management Systems	✓	▪ Under the 2013 European Directive "on safety of offshore oil and gas operations," a Safety and Environmental Management System must be submitted to the Health and Safety Executive (HSE)/Department of Energy and Climate Change (DECC) for any offshore installation. ▪ Safety and Environmental Management System requirements for United Kingdom offshore operations are outlined in Article 8 of the UK Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations 2015.
United States	✓	Safety and Environmental Management System (SEMS) Program	✓	▪ Safety Management System required, as outlined in US Code of Federal Regulations, Title 30 Subpart S – Safety and Environmental Management Systems. In addition to regulatory requirements prescribed in the federal regulations, the safety management systems must address elements in the American Petroleum Institute Standard RP75 "Recommended Practice for Development of a Safety and Environmental Management Program (SEMP)[14]."

Country	Statutory/regulatory SMS requirement?	SMS nomenclature	SMS required across all operations?	SMS Description/Scope (phases of offshore activity regulated)
Venezuela	✖	n/a	n/a	No statutory/regulatory Safety Management System (SMS) requirements in place. The Venezuelan national oil company, Petroleos de Venezuela, S.A. (PVDSA) publishes its own safety regulations for application in its operations, including Guidelines for System of Integral Risk Management (Lineamientos del Sistema de Gerencia Integral del Riesgos).

6 Offshore Operations Real time monitoring, Equipment failure reporting systems, and Accident near miss reporting

Real time monitoring refers to the use of high-tech equipment to collect and instantaneously analyze offshore operational data. Real time monitoring is especially useful for technically challenging drilling operations, such as high pressure high temperature formations, where it is difficult to maintain pressure balance to protect the integrity of the wellbore. Real time monitoring of offshore operations from remote locations/operations centers is a new industry phenomenon and involves the use of new technology, such as fiber optic cable connections between locations for data/information transfer. This is a newer industry phenomenon performed by larger operators, such as BP[15]. Remote real time monitoring centers may be operated 24/7 by highly trained experts who aid in making live decisions during offshore operations. Considerations taken into account by operators on the use of real time monitoring technology include economic benefit analysis and potential for reduction of risk/SHE concerns. Additional methods of real time monitoring include the use of satellite imagery to position drill rigs, measurement while drilling technology (MWD) to help steer drilling and assess geological features, and seismic and environmental data collection and analysis.

There are no explicit real time monitoring provisions with respect to the latest technological advancements for offshore operations on remote/onshore facilities for any of the priority countries, though many nations include more general monitoring guidelines for all types of offshore activities within regulations and/or Management Systems requirements. National regulations and guidelines may outline items such as performance standards for specific operations (e.g. well control or cementing operations), equipment or operational technical specifications, inspection/verification processes for equipment/operations, and/or communication/reporting between operators and regulators throughout certain operations/events. An example of offshore monitoring is the use of operator/contractor personnel and experts (e.g. drilling engineers and, geologists) to observe and document activities and associated operational data at particular stages, such as during drilling events and well completions/workovers. During observation of offshore activities, the exploration and production company representatives generally have the final word on overall performance of operations. Priority country offshore statutory/regulatory monitoring requirements are listed and described in 6.1.

Regarding oversight, monitoring, and compliance on equipment failure reporting and accident near misses, priority countries generally require operators to notify the offshore regulatory agencies and/or submit written reports detailing the events and measures taken to address any potential consequences. On equipment failure reporting, several countries include specific requirements on notifying installation personnel as well as regulators. For example, in the Norwegian regulatory framework there are several requirements for emergency notification systems on installations, as well as reporting requirements to regulators during drilling and other well activities. For accident near miss reporting, Norwegian regulations stand out as near miss accidents are included in the broader accident reporting framework, as opposed to being listed as a separate category of reportable incidents. This is highlighted in Section 29 of the Norwegian Management Regulations which states “operators should immediately notify the Petroleum

Safety Authority (by telephone) "in the event of hazard and accident situations that have led to, or under slightly altered circumstances could have led to:

- Death;
- Serious and acute injury;
- Acute life-threatening illness;
- Serious impairment of discontinuance of safety related functions or barriers, so that the integrity of the offshore or onshore facility is threatened; and
- Acute pollution.
- Near miss accidents are not listed as incidents (along with deaths, etc.) and the near miss categorization is rather applied to the entire reporting structure for "hazardous and accident situations."[16]

By structuring their regulations in this manner, Norway is implicitly producing a trigger that simultaneously causes operators to make a judgement call on what events may meet the criteria for near misses, in addition to increasing communication between regulator and operator through increased questions and clarifications.

Incorporation of accident near miss requirements into offshore legislation may provide regulators with more complete information regarding offshore risks, incidents, and issues. In assembling a more complete list of incidents, including near misses, the regulator may be considered better informed or 'equipped' to define and regulate high risk aspects of offshore operations and prioritize features of facility inspections. The Norwegian PSA indicates that through collection of industry data, including on accidents and near misses, specific risk areas with the highest probability of major accidents have been identified, which include: hydrocarbon leaks, serious well incidents, damage to load-bearing structures and maritime systems, and ships on a collision course[17].

Table 7 below provides a coverage overview of what phases of offshore activity have real-time monitoring requirements for offshore operations, equipment failure and accident reporting requirements according to priority country regulatory documents. Checks indicate coverage of the topic in country statutory/regulatory provisions, and circles indicate no/very limited coverage of the topic.

Table 8 provides a qualitative and color-coded quantitative ranking of priority countries with respect to general criteria (e.g. quality of enforcement/enforcer) and specific criteria relevant to real-time monitoring, equipment failure and accident reporting (e.g. Regulator supported by Verification Bodies for critical equipment). Input from industry SMEs in addition to research were used to provide the basis for comparing and contrasting each priority country. Qualitative Harvey Balls are used from a full ball (i.e. high quality) to a quarter ball (i.e. lower quality) where an empty ball indicates nothing is in place in the regulations.

Table 7 – Overview of Real Time Monitoring of Offshore Operations, Equipment Failure, and Near Miss Reporting

Requirement \ Country	US	UK	NO	CA	MX	DK	IS	AU	RU	VE	CU	NZ	TT	NL	BR	JM	BS
Real Time Monitoring of Offshore Operations																	
Oversight	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Monitoring	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Compliance	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Equipment Failure Reporting																	
Oversight	✓	✓	✓	✓	✓	✓	○	✓	✓	○	○	✓	○	✓	○	○	○
Monitoring	✓	✓	✓	✓	✓	✓	✓	✓	○	○	○	✓	○	✓	○	○	○
Compliance	✓	✓	✓	✓	✓	✓	○	✓	○	○	✓	✓	○	✓	✓	○	○
Accident/Near Miss Reporting																	
Oversight	✓	✓	✓	✓	○	✓	○	✓	○	○	○	✓	○	✓	○	○	○
Monitoring	✓	✓	✓	✓	○	✓	○	✓	○	○	○	✓	○	✓	○	○	○
Compliance	✓	✓	✓	✓	○	✓	○	✓	○	○	○	✓	○	✓	○	○	○

Legend

✓	Covered in regulations
○	Not covered in regulations

Table 8 - Assessment of Real Time Monitoring of Offshore Operations, Equipment Failure, and Near Miss Reporting across Priority Countries

Requirement \ Country	US	UK	NO	CA	MX	DK	IS	AU	RU	VE	CU	NZ	TT	NL	BR	JM	BS
Real Time Monitoring																	
Country Ranking	4	2	1	5	12	11	9	3	7	13	14	6	14	10	8	16	17
Quality of Enforcement	◔	●	●	○	○	○	○	◑	○	○	○	○	○	○	○	○	○
Quality of Enforcer	◔	●	●	○	○	○	○	◑	○	○	○	○	○	○	○	○	○
Regulator supported by Verification Bodies for critical equipment	◔	●	●	◔	○	○	○	●	○	○	○	○	○	○	○	○	○

Legend

●	High Level of Quality	◔	Low Level of Quality
◑	Medium Level of Quality	○	Nothing in Place

6.1 Real Time Monitoring of Offshore Operations

For nearly all priority countries, there is no explicit statutory/regulatory basis for real time monitoring of offshore operations involving remote observation of technical/performance indicators. Nearly all priority countries have general regulatory provisions for maintaining SHE standards during performance of offshore operations, and there is an emphasis on expedient monitoring, reporting, and remediation of mishaps/accidents. Fewer countries have monitoring and performance requirements for specific pieces of equipment/operations to address respective SHE concerns for these items/activities.

Australia

There are no explicit real time monitoring requirements in the Australian regulatory framework. An installation's safety case, submitted by the operator and approved by NOPSEMA, is the basis for health, safety, and environmental regulation at a particular offshore facility. Part 2 (Safety Cases), Article (3) of the Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009 states that "the safety case for [a] facility must also contain a detailed description of the safety management system that:

- Provides for continual and systematic identification of hazards to health and safety of persons at or near a facility;
- Provides for the reduction to a level that is as low as reasonably practicable of risks to health and safety of persons at or near a facility, including, but not limited to:
    - (i) risks arising during evacuation, escape and rescue in case of emergency;
    - (ii) risks arising from equipment and hardware;
- Provides for inspection, testing, and maintenance of the equipment and hardware that are the physical control measures for those risks, and;
- Provides for adequate communications between the facility and any relevant facility, vessel, aircraft, or on-shore installations[18].

In a Well Operations Management Plan (WOMP), operators may submit information to NOPSEMA on criteria used to monitor well performance. NOPSEMA states, "a Management Strategy and realistic performance objectives and measurement criteria used to assess the extent to which the identified hazards have been or are being managed to an acceptable level compatible with the well life expectancy e.g. through links to Titleholder management systems[19]."Additional requirements are outlined in Division 3 of the Australian Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration Regulations). This describes how operators must submit daily drilling reports, initial well completion reports (and associated data), and final well completion reports (and associated data) to the Titles Administrator.

Bahamas

There are no real time monitoring provisions identified in the Bahamian offshore regulatory framework.

Brazil

There are several monitoring programs in the Brazilian offshore regulatory framework, although these are focused on monitoring marine traffic and are not explicitly aimed at monitoring equipment/operations at offshore facilities. These programs include:

- The Information System on Maritime Traffic (Sistema de Informações Sobre o Tráfego Marítimo - SISTRAM), the Maritime Monitoring System of Support for Petroleum Activities (Sistema de Monitoramento Marítimo de Apoio às Atividades de Petróleo - SIMMAP), the System for Identification and Monitoring of Long Distance Vessels (Sistema de Identificação e Acompanhamento de Navios a Longa Distância - LRIT), and the Maritime Monitoring System in support of Petroleum Activities (Sistema de Monitoramento Marítimo de Apoio às Atividades de Petróleo - SIMMAP).
    - The SIMMAP program has the most direct role in health, safety, and environmental issues in offshore oil/gas activities. The system's overall goals include to monitor vessels related to the oil and gas industry to increase traffic safety and protection, contribute towards regulatory supervision of oil/gas activities by other authorities, and aid in investigations of any accidents involving tracked vessels.

Performance/goal-based standards related to operational safety critical systems are addressed in the National Petroleum Agency (ANP) Regulation Number 43/2007 on Operational Safety Management Systems in the offshore oil/gas industry. Operational safety critical systems are defined as any engineering control systems designed to keep a facility operating within safe operational limits, halt in part or completely an installation or process, and reduce human exposure to consequences of failure.

Canada

There is no explicit reference to real time monitoring in the Canadian offshore regulatory framework, although there are several monitoring requirements in place regarding safety, health, and environmental (SHE) concerns in offshore operations. Part 4 of the Canada Oil and Gas Drilling and Production Regulations address items regarding monitoring offshore equipment and operations. General performance-based guidance for offshore operations is that "all wells, installations, equipment and facilities are designed, constructed, tested, maintained and operated to prevent incidents and waste under the maximum load conditions that may be reasonably anticipated during any operation." For example, additional requirements for specific equipment/operations are below.

- Drilling fluid system: Article 28 states the operator shall ensure "(*a*) the drilling fluid system and associated monitoring equipment is designed, installed, operated and maintained to provide an effective barrier against formation pressure, to allow for

proper well evaluation, to ensure safe drilling operations and to prevent pollution; and (*b*) the indicators and alarms associated with the monitoring equipment are strategically located on the drilling rig to alert onsite personnel."

- Drilling practices: Article 30 states, "The operator shall ensure that adequate equipment, procedures and personnel are in place to recognize and control normal and abnormal pressures, to allow for safe, controlled drilling operations and to prevent pollution."

- Well Control: Article 35 states, "The operator shall ensure that adequate procedures, materials and equipment are in place and utilized to minimize the risk of loss of well control in the event of lost circulation."

Cuba

There are no specific real time monitoring provisions required, though the Cuban Safety Case guidelines released by the Cuban Office of Environmental and Nuclear Regulation (Oficina de Regulación Ambiental y Seguridad Nuclear (ORASEN), [based on International Association of Drilling Contractors 2006 guidelines], states that operators must have an emergency response plan to deal with all identified hazards and risks.

Denmark/Greenland

In Denmark and Greenland, there are no real-time monitoring requirements for offshore operations, though there are reporting requirements for offshore incidents/accidents.

- Notably, in Greenland, supervision of offshore health and safety is referenced in the Mineral Resources Act which states supervisory activities should be performed according to guidelines in the Mineral Resources Act itself and other legislation and rules. Overall guidance is the licensee "ensures and supervises that the health and safety risks are identified, assessed and reduced as much as is practically possible...[20]" The Act states further provisions may be established by the Greenland government in the spheres of "management of safety and health, on safety and protection zones, on the construction and dismantling of offshore facilities as well as on equipment, approvals, supervision, emergency preparedness, life-saving measures, training requirements, working hours, etc.[21]"

Iceland

There are general regulatory provisions for monitoring of offshore operations in the Icelandic regulatory framework. Act Number 13 states "the licensee shall ensure that hydrocarbons activities take place in a responsible manner in accordance with the Legislation that is in effect at any given time…the measures of the Licensee regarding the planning and size of activities shall be such that the Licensee can at any given time make informed decisions on its hydrocarbon activities[22]."

Jamaica

There are no identified provisions on operations real time monitoring in the Jamaican offshore regulatory framework.

Mexico

There are no identified provisions on operations real time monitoring in the Mexican offshore regulatory framework. Accident/incident reporting measures for offshore operations in Mexico are described in the subsequent section.

Netherlands

There are provisions regarding daily monitoring of offshore drilling operations in the Netherlands regulatory framework, per the Dutch Mining Regulations (Article 8.2.2.1) which states daily reports are due to the State Supervision of Mines on the "profile of every borehole." The daily reports are required to contain several pieces of information, including project details (e.g. names of managers), drilling operation (e.g. type and purpose of drilling operation and geographical coordinates of the spudding location), the mining or drilling rig (e.g. name of installation and names of owners), well details (e.g. depth, deviation), casing (e.g. dimensions, cement type/weight/volume, and a casing diagram), drilling mud (type of mud, specific gravity of drilling mud as function of depth), as well as geological data, hydrocarbons found, and well completion operations[23].

New Zealand

Real-time monitoring requirements are not explicitly addressed in the New Zealand regulatory framework. The general principle underlying operations monitoring in the country is that an operator is legally required to design, construct, and operate a well in such a way that "there can be no unplanned escape of fluids" during the lifetime of a well or after its abandonment, and to ensure health and safety risks are "as low as is reasonably practicable." Additional national monitoring requirements/guidelines are listed below.

- The operator must submit a comprehensive safety assessment to WorkSafe (New Zealand offshore regulatory body) for approval before well drilling begins. Secondly, an operator must put in place a well examination scheme to ensure the well is actually built and operated in accordance with the regulations. This includes testing of the well once it is constructed and throughout the well's life (see Box 4.1). The scheme must be overseen by an "independent and competent person".

- Regulation 76 of the Health and Safety in Employment (Petroleum Exploration and Extraction) Regulations 2013 states a well operator must make and retain daily well operation reports and store them until 12 months after abandonment of the well for the following activities: a) well drilling operation; b) well-completion operation; c) workover operation; d) suspension or abandonment operation; and e) any other operation involving substantial risk of the unplanned escape of fluids from the well. Various forms of checking compliance are also utilized across New Zealand. Whether through direct

inspections or third party "well examiners", local councils and WorkSafe itself are empowered to visit well sites regularly and inspect operations to ensure compliance with requirements.

- The HSE regulations require operators to fill out a "Schedule 1" as part of their "Matters to be addressed by safety management systems for installation[24]". A section of the Schedule 1 includes details regarding performance monitoring, whereby it is up to the operator to make arrangements for reporting incidents and other issues related to major accidents. Specifics are not identified for the role of WorkSafe nor other agencies in engaging in more detailed monitoring. These same requirements are also in place in the "Schedule 4" document, which outlines the "Information required in safety case for installation". Guidelines are given to encourage baseline monitoring to aid in determining when a leak or failure has occurred. Local regional councils are moving towards requiring more formal monitoring of drilling and production activities.

- In addition, WorkSafe describes that monitoring arrangements should be in place between the accredited inspection body which issues a Certificate of Fitness for an installation and a duty holder. In the Certificate of Fitness Interpretive Guidelines for offshore installations under the Health and Safety in Employment Regulation 2013, WorkSafe states "the inspection body should have agreed monitoring processes in place with the duty holder for any installation for which the inspection body has provided a certificate of fitness[25]."

Norway

The Norwegian Facilities Regulations provides performance-based requirements for offshore operations monitoring by operators. Section 8 of the regulation states, "Facilities shall be equipped with necessary safety functions that can at all times: a) detect abnormal conditions; b) prevent abnormal conditions from developing into hazard and accident situations; and c) limit the damage caused by accidents. Requirements shall be stipulated for the performance of safety functions. The status of active safety functions shall be available in the central control room[26]." Further provisions on or related to offshore operations monitoring are provided below.

- The Norwegian Management Regulations issued by the Petroleum Safety Authority, Norwegian Environment Agency, and Norwegian Directorate of Health, establish risk reduction as a primary goal for offshore operations. Section 5: establishes "that barriers shall be established that at all times can: a) identify conditions that lead to failures, hazards, and accident situations; b) reduce the possibility of failures, hazard, and accident situations occurring and developing; and c) limit possible harm and inconveniences." Section 9 of the Management Regulations states that operators shall set acceptance criteria for listed major accident and environmental risks: "a) the personnel on the offshore or onshore facility as a whole, and for personnel groups exposed to a particular risk; b) loss of main safety functions are mentioned in Section 7 of the Facilities

Regulations for offshore petroleum activities; c) acute damage from the offshore or onshore facility; and d) damage to third party[27]."

- Section 19 of the Norwegian Management Regulations provide guidelines for collection, processing, and use of operational data. The regulation states, "The responsible party shall ensure that data of significance to health, safety, and the environment are collected, processed, and used for: a) monitoring and checking technical, operational, and organizational factors; b) preparing measurement parameters, indicators, and statistics; c) carrying out and following up analyses during various phases of the activities; d) building generic databases; e) implementing remedial and preventive measures, including improvement of systems and equipment[28]."

- Monitoring practices for specific drilling and well operations/hazards are listed in Chapter XV of the Activities Regulations. Covered operations include well location and wellbore, shallow gas and shallow formation fluids, monitoring well parameters, well barriers, well control, controlled well stream, well security, and remote operation of pipes and work strings.

Chapter IX, Sections 34-38 of the Norwegian Management Regulations cover items regarding offshore petroleum activities reporting to regulatory authorities, including:

- Programme for drilling and well activities (Section 37) states, "The responsible party shall ensure that the programme for and information on drilling and well activities are submitted to the Petroleum Safety Authority in Norway in accordance with deadlines stipulated by the Petroleum Safety Authority Norway[29]."

- Drilling and well activities (Section 38). For this item, the regulation states, "The operator shall report drilling and well activities to the Petroleum Safety Authority Norway's and Norwegian Petroleum Directorate's database[30]."

Russia

There are no provisions on real-time monitoring of offshore operations in the Russia offshore regulatory framework. To protect the environment and to ensure safe operations, Russian authorities systematically monitor the implementation of mandatory requirements related to offshore drilling. Additionally, other provisions exist where the License Owner shall contact the onshore services of the Russian Federation on a regular basis. For example, if appropriate equipment is available, an operator shall communicate on-line meteorological and hydrological monitoring data to the nearest meteorological station of the Russian Federation within established international terms. While the Russian authorities show a preference for obtaining real time monitoring data (if available), operators are not required to share this data, and regulations do not require real time monitoring of all equipment. For example, at the Sakhalin Island development, real time monitoring capabilities for meteorological, hydrological, and

environmental emissions data were installed, although Exxon Mobil, did not share this data with regulators.

Trinidad and Tobago

There are no provisions on operations real time monitoring identified in the offshore regulatory framework of Trinidad and Tobago.

United Kingdom

There are no real-time monitoring requirements in the United Kingdom regulatory framework, although there are operations monitoring requirements operators must adhere to when performing certain activities. These requirements are focused on maintaining performance standards for safety critical elements throughout the lifetime of an installation.

- Safety critical elements (SCEs) are defined by the HSE as "any structure, plant, equipment, system (including computer software) or component part whose failure could cause or contribute substantially to a major accident." All SCEs are identified in the safety case and duty holders (installation owners/operators) must appoint an independent organization as "Verifier" of SCEs. A Verification Scheme is a document which ensures that SCEs at an installation are suitable, or appropriate for intended use, dependable and effective when required, and able to perform as intended.

- The Verification Scheme should provide independent review/inspection to establish continued effectiveness throughout an installation's lifecycle, and be updated when industry standards/technology/knowledge change; it must be shown that all SCEs are suitably designed/constructed and will be properly maintained[31].

- Additionally, under the Offshore Installation and Wells (Design and Construction, etc.) Regulations 1996, well operators are required to prepare well examination schemes to verify that each well "is designed, constructed, and maintained in safe condition throughout its life from initial design to final abandonment[32]." The HSE states that there should be an interface between a well examination scheme and an installation verification scheme, to avoid any gaps between the two. For example, the HSE notes that the well's blowout preventer and christmas tree may be covered by a verification scheme, and therefore may not need to be included in the well examination scheme.

United States

There are regulatory requirements for monitoring of operations/equipment and other processes in the U.S. offshore regulatory framework. These monitoring requirements are outlined as follows:

- Well control monitoring requirements for offshore operations are outlined in U.S. CFR Title 30, Part 250, Subpart D. This part states, "You must take all necessary precautions to keep wells under control at all times. You must: (a) Use the best available and safest

drilling technology to monitor and evaluate well conditions and to minimize the potential for the well to flow or kick; (b) Have a person onsite during drilling operations who represents your interests and can fulfill your responsibilities; (c) Ensure that the toolpusher, operator's representative, or a member of the drilling crew maintains continuous surveillance on the rig floor from the beginning of drilling operations until the well is completed or abandoned, unless you have secured the well with blowout preventers (BOPs), bridge plugs, cement plugs, or packers; (d) Use personnel trained according to the provisions of subpart O; and (e) Use and maintain equipment and materials necessary to ensure the safety and protection of personnel, equipment, natural resources, and the environment[33].”

- Under U.S. CFR Title 30 Part 250.282, the Regional Supervisor may direct operators to conduct monitoring programs after approval ("post-approval") of any Exploration Plan (EP), Development and Production Plan (DPP), and Development Operations Coordination Plan (DOCD)[34]. This part states, "The Regional Supervisor may require [operators] to [submit]:

  (a) Monitoring plans. Submit monitoring plans for approval before you begin work; and

  (b) Monitoring reports. Prepare and submit reports that summarize and analyze data and information obtained or derived from your monitoring programs. The Regional Supervisor will specify requirements for preparing and submitting these reports.”

- Under U.S. CFR Title 30, Part 250.403, Operators must report to the District Manager "the movements of all drilling units on and off drilling locations."

- Under Part 250.519 of Title 30, casing pressure must be monitored at production installations at intervals determined by the type of production facility; the intervals range from continuously (for subsea and hybrid wells) to monthly (for fixed platform well). Casing diagnostic tests must be performed at time periods ranging from immediately to once every five years, depending on the circumstances (See section 250.523: When do I have to repeat casing diagnostic testing?) . Records of casing pressure and diagnostic tests must be kept at the "field office nearest the well until the well is abandoned."

- Monitoring equipment requirements for drilling fluids are presented in Part 250.457. This section states, "Once you establish drilling fluid returns, you must install and maintain the following drilling fluid-system monitoring equipment throughout subsequent drilling operations. This equipment must have the following indicators on the rig floor: (a) Pit level indicator to determine drilling fluid-pit volume gains and losses. This indicator must include both a visual and an audible warning device; (b) Volume measuring device to accurately determine drilling fluid volumes required to fill the hole on trips; (c) Return

indicator devices that indicate the relationship between drilling fluid-return flow rate and pump discharge rate. This indicator must include both a visual and an audible warning device; and (d) Gas-detecting equipment to monitor the drilling fluid returns. The indicator may be located in the drilling fluid-logging compartment or on the rig floor. If the indicators are only in the logging compartment, you must continually man the equipment and have a means of immediate communication with the rig floor. If the indicators are on the rig floor only, you must install an audible alarm."

- Title 30, Part 250.514 establishes that during well completion operations, "a well shall be continuously monitored...and shall not be left unattended at any time unless the well is shut in and secured."

- Regarding casing pressure testing, U.S. CFR Title 30, Part 250, 4323 describes operator requirements for reporting/documentation of casing pressure testing results, to be made available to BSEE upon request. Part 250,423 states, "the BSEE District Manager may require you to perform additional negative pressure tests on other casing strings or liners (e.g. intermediate casing string or liner) or on wells with a surface BOP stack[35]."

- Title 30, Part 250.446 establishes BOP inspection and maintenance requirements. Operators are required to document compliance with API BOP standards, record results of BOP inspections and maintenance actions, and make the records available to BSEE upon request. The records must be maintained on the rig for years from the date they are created, or for a longer period if directed by BSEE. Part 250.446 fully states, "You must maintain and inspect your BOP system to ensure that the equipment functions properly. The BOP maintenance and inspections must meet or exceed the provisions of Sections 17.10 and 18.10, Inspections; Sections 17.11 and 18.11, Maintenance; and Sections 17.12 and 18.12, Quality Management, described in API RP 53, Recommended Practices for Blowout Prevention Equipment Systems for Drilling Wells (incorporated by reference as specified in §250.198). You must document how you met or exceeded the provisions of Sections 17.10 and 18.10, Inspections; Sections 17.11 and 18.11, Maintenance; and Sections 17.12 and 18.12, Quality Management, described in API RP 53, record the results of your BOP inspections and maintenance actions, and make the records available to BSEE upon request." Paragraph b states that operators may use television cameras to inspect subsea equipment.

Venezuela

There are no prescriptive real-time monitoring requirements identified in the Venezuelan offshore regulatory framework. National regulations contain general guidelines regarding oversight/monitoring of offshore operations; including that operators perform offshore activities "continuously and in an efficient manner, conforming to the best available scientific and technical practices[36]." Article 8 of the Venezuelan Organic Law on Hydrocarbons establishes the Ministry of Energy and Mining as the authority to monitor, inspect, and audit hydrocarbon facilities.

6.2 Equipment Failure Reporting Systems

Across the majority of priority countries, there are systems in place for reporting SHE hazards during offshore operations. Regarding equipment failure, most priority countries do not have prescriptive requirements detailing oversight, monitoring, or compliance regarding specific pieces of equipment. Instead, countries require operators to adhere to performance standards, such as maintaining well control and operators must report/describe dangerous occurrences (which may have involved failed equipment) to regulatory authorities. In country regulations without specific regulatory failure reporting clauses on certain pieces of offshore equipment (e.g. platform stability, BOPs/well control equipment), operators are given some flexibility in determining which accidents meet the definition of reportable incidents or dangerous occurrences. For example, in Australia, in addition to listed items which must be reported which may be related to equipment failure (such as near misses, well kicks greater than 50 barrels, and damage to safety critical equipment), regulatory guidance also states that regulatory authorities must be notified and written reports must also be submitted for "any other occurrences that a reasonable operator would consider to require an immediate investigation[37]." The offshore regulator in Australia NOPSEMA indicates that an operator should contact NOPSEMA when in doubt as to whether or not an incident needs to be reported. Priority country statutory/regulatory provisions for dangerous occurrence reporting and compliance which either reference or allude to offshore equipment and infrastructure are provided below.

Australia

"Accidents and other dangerous occurrences" must be reported to NOPSEMA including "unplanned events that required the emergency response plan to be implemented, damage to safety critical equipment, and any other occurrences that a reasonable operator would consider to require an immediate investigation[38]."

- These incidents are required to be reported to NOPSEMA through a phone line and written reports are to be submitted to NOPSEMA "within 3 days of the accident, or detection of a dangerous occurrence, unless otherwise agreed by NOPSEMA." A final report is submitted to NOPSEMA after 30 days. It is an offense of strict liability not to notify and report accidents and dangerous occurrences to NOPSEMA.

- Written reports (due within three days of the accident or dangerous occurrence) cover several areas, including general items (e.g. facility name, brief description of incident, actions taken to make work site safe), injuries sustained, fluid escape (e.g. estimated quantity and duration), serious damage (e.g. equipment damaged and to what extent), and immediate actions/causes (immediate actions taken/intended, if any, to prevent recurrence of incident) and an immediate cause analysis).

- A final report (due within 30 days of the accident or dangerous occurrence) includes all documentary material referenced and/or relied on in the written report (including but not limited to, witness statements, SMS documents, drawings, diagrams and photographs, third party reports - audit, inspection, material analysis, and internal records and

correspondences. A final report also includes two additional items: a root cause analysis and full report and actions to prevent recurrence of the same of similar incident with responsible party and completion date. Monthly environmental incident reports are also required to be submitted to NOPSEMA in the Australian regulatory framework.

Bahamas

Some equipment failure reporting provisions are included in the Bahamian Petroleum Regulations. Article 42 (2) addresses measures operators should take to prevent well blowouts. The Article states, "A licensee or less shall take all reasonable precautions to prevent any well from blowing out and shall take immediate steps and exercise due diligence to bring any well under control." Article 49 (2) provides well logging requirements for operators during drilling operations. Article 32 of the Bahamian Petroleum Regulations, Part II: Form of Licence, states that "The Licensee shall forthwith notify the Minister in writing of any accident occurring in or about the licensed area; and the Minister may, if he thinks fit, on the receipt of such notification, conduct an enquiry into such accident."

Brazil

No provisions on offshore equipment failure reporting systems are identified in the Brazilian regulatory framework. Operators must submit operational safety documentation outlining the safety management system in place at an installation in compliance with National Petroleum Agency (ANP) Regulation Number 43/2007 on Operational Safety Management Systems in the offshore oil/gas industry.

Canada

- Management Systems are used to address compliance with identifying and addressing health, safety, and environmental concerns by operators. The Canada Oil and Gas Drilling and Production Regulations state that a management system shall include items such as:
  - "...Processes for identifying hazards and for evaluating and managing the associated risks…processes for ensuring and maintaining the integrity of all facilities, structures, installations, support craft and equipment necessary to ensure safety, environmental protection, and waste prevention…processes for internal reporting and analysis of hazards and for taking corrective action to prevent their recurrence[39]."

- A safety plan is be submitted outlining "procedures, practices, resources, sequence of key safety-related activities and monitoring measures necessary to ensure the safety of the proposed work or activity." The following items are required in a safety plan:
  - "a summary of the studies undertaken to identify hazards and to evaluate safety risks related to the proposed work or activity; a description of the hazards that were identified and the results of the risk evaluation; a summary of the measures to avoid, prevent, reduce and manage safety risks; a list of all structures, facilities, equipment and systems critical to safety and a summary of the system in place for

their inspection, testing and maintenance; a description of the organizational structure for the proposed work or activity and the command structure[40].”

- Standards (generally performance-based) for monitoring specific offshore operations aimed at minimizing SHE risk are provided in the Canada Oil and Gas Drilling and Production Regulations. An example is for drilling operations, for which the regulations state, “The operator shall ensure that adequate equipment, procedures and personnel are in place to recognize and control normal and abnormal pressures, to allow for safe, controlled drilling operations and to prevent pollution[41].”

- Certificates of fitness are issued to offshore installations which affirm that an installation is “designed, constructed, transported, and installed” in accordance with Newfoundland and Nova Scotia offshore regulations.

Cuba

Equipment failure reporting systems are addressed in the Cuban Safety Case guidelines released by the Cuban Office of Environmental and Nuclear Regulation (Oficina de Regulación Ambiental y Seguridad Nuclear (ORASEN), [based on International Association of Drilling Contractors 2006 guidelines], which states that operators must have an emergency response plan, including response procedures for equipment failure situations including: mooring failure, structural failure, loss of well control, and foundation failure.

Denmark/Greenland

There are reporting requirements for equipment failures in Denmark and Greenland. In Denmark, regulatory authorities are required to be notified immediately regarding “significant damage to the offshore installation or equipment related to health and safety[42].” In Greenland, license holders are required to report “significant events” to the Mineral Licensing and Safety Authority (MLSA).

Safety critical elements (SCEs) are a focus of risk analysis, management, and inspection in Danish offshore regulation. SCEs are defined as "installation parts, equipment and components (including computer programs) a) which by failure may be the cause of or contribute significantly to major accidents or b) whose purpose is to prevent or limit the consequences of such accidents (examples of SCEs provided by Danish regulatory authorities include flame, smoke, gas and H2S detectors, alarms, firefighting equipment, emergency power supply, uninterruptible power supply (emergency shut down-ESD), rescue equipment, bearing structures, escape routes, and muster area.”

Iceland

Regulation Number 884, Section X, Article 57, cover operator offshore notification requirements to the National Energy Authority. The article states, “The licensee shall immediately notify the National Energy Authority of any event or circumstances that could lead to the discontinuation of offshore facilities, reduced extraction of hydrocarbons of have any effect on activities

stipulated in administrative decisions made on the basis of the Hydrocarbon Act or this Regulation[43]."

Jamaica

There are no provisions on equipment failure reporting systems in the Jamaican offshore regulatory framework.

Mexico

There are interpreted provisions for addressing equipment failure reporting situations in the Mexican offshore regulatory framework. The National Agency of Industrial Safety and Environmental Protection was created in August 2014 to serve as the technical and regulatory authority in the hydrocarbon sector to enforce pre-existing federal regulations and issue its own regulations on operational safety and environmental protection in the hydrocarbon sector.

- The National Hydrocarbons Commission (current offshore regulator) Regulation 12.001/10 establishes that the Commission must be immediately notified in the event of any accident/incident that endangers life, health, public safety, and security and in response apply corresponding contingency plans, emergency measures, and containment action.
    - A report on accident/incident events and control measures is required to be submitted to the National Hydrocarbons Commission no more than 10 days after the incident, and a more detailed report on accident/incident causes, response measures taken, and remediation action is required to be submitted after no longer than 180 days.

Netherlands

- There are reporting requirements for operators to the State Supervision of Mines for "accidents or incidents through which the strength or stability of a mining installation is harmed or is threatened to be harmed" as well as for "deviations in the pressure in the tubing/casing annulus and the first casing casing/casing annulus of producing, injecting, and closed-in wells[44]."

- To control an incident, the Dutch Minister is authorized to issue direction on how control activities should be performed, as well as specify that a body with relevant competence/expertise perform the activities.

- Article 85 of the Mining Regulation states an operator shall ensure that a disaster control plan is prepared for exploration or production operations. The disaster control plan shall be revised every five years and submitted for approval by the Minister. The plan must be submitted at least four weeks before start of exploration or production operations. The plan is assumed to be approved if the Minister has not taken a decision within 4 weeks after receipt of the plan. As soon as possible after an incident (no situations/examples

listed in regulation), the operator must report this to the State Supervision of Mines. A disaster control plan must contain at least the following (Article 86): activities performed to control an incident, the materials and control facilities present, specification of who or which body is responsible for materials/facilities in question, and specification of who or which body is responsible for supervising the incident control activities.

New Zealand

There are general provisions on equipment failure reporting in the New Zealand offshore regulatory framework. Overall, the primary duty of operators is summarized in Regulation 78 of the Health and Safety in Employment (Petroleum Exploration and Extraction) Regulations 2013, which states, "the duty holder must notify WorkSafe of any dangerous occurrence as soon as practicable after the occurrence becomes known to the duty holder[45]."

- Overall, the safety case and associated safety plans place the responsibility on the duty holder to report and handle situations related to failures and accident near misses. However, recently there has been a push to add more regulatory oversight to actively monitor these parameters.

Norway

Chapter XIII, Section 29 of the Norwegian Management Regulations outlines hazards/accidents reporting to regulatory authorities. Items which must be reported by telephone to the Petroleum Safety Authority (PSA) include "serious impairment of discontinuance of safety related functions or barriers, so that the integrity of the offshore or onshore facility is threatened," as well as acute pollution and personnel injury/death. The PSA requires written follow-up notification subsequent to notification by phone[46].

- Chapter IX, Sections 36 of the Norwegian Management Regulations covers reporting for damage to load bearing structures and pipeline systems. This section states, "The operator shall ensure that damage to and incidents in connection with load-bearing structures and pipeline systems are reported to the Petroleum Safety Authority Norway's Corrosion and Damage (CODAM) (in Norwegian only) database[47]."

- Chapter V of the Norwegian Facilities Regulations addresses requirements for "physical barriers", including fire and gas detection systems, emergency shutdown systems, process safety systems, control and monitoring systems, and gas relief systems. Text from the regulations which address failure/emergency reporting are listed below.

    - For fire and gas systems: "Facilities shall have a fire and gas detection system that ensures quick and reliable detection of near-fires, fires and gas leaks. The system shall be able to perform the intended functions independently of other systems. In the event of fire or gas detection, automatic actions shall limit the consequences of the fire or gas leak. The placement of detectors shall be based on relevant scenarios and simulations or tests[48]."

- For emergency shutdown systems: "Facilities shall have an emergency shutdown system that can prevent the development of hazard and accident situations and limit the consequences of accidents, cf. Section 7. The system shall be able to perform the intended functions independently of other systems. The emergency shutdown system shall be designed so that it enters or maintains safe conditions if a fault occurs that can prevent the system from functioning. The emergency shutdown system shall have a simple and clear command structure. The system shall be capable of being activated manually from trigger stations that are located in strategic locations on the facility. It shall be possible to manually activate functions from the manned control center that bring the facility to a safe condition independently of the parts of the system that can be programmed. Emergency shutdown valves shall be installed that can stop streams of hydrocarbons and chemicals to and from the facility and to and from wells, and which isolate and/or partition the fire areas on the facility. Facilities outfitted with or attached to process facilities, shall have a process safety system. The system shall be able to perform the intended functions independently of other systems. The process safety system shall be designed such that it enters or maintains a safe condition if a fault occurs that can prevent the system from functioning. The process safety system shall be designed with two independent levels of safety to protect equipment[49]."

- For process safety systems: "Facilities outfitted with or attached to process facilities, shall have a process safety system. The system shall be able to perform the intended functions independently of other systems. The process safety system shall be designed such that it enters or maintains a safe condition if a fault occurs that can prevent the system from functioning. The process safety system shall be designed with two independent levels of safety to protect equipment[50]."

- For control and monitoring systems: "Facilities shall have control and monitoring systems which, using associated alarms, warn of incidents, nonconformities or faults that are significant for safety. The alarms shall be issued such that they can be perceived and responded to within the time required for safe use of equipment, plants and processes[51]."

- Maintenance of facilities and equipment are covered beginning in Chapter IX of the Norwegian Activities Regulations, issued by the Petroleum Safety Authority, Norwegian Environment Agency, the Norwegian Directorate of Health, and the Norwegian Food Safety Authority. The Regulation states, "the responsible party shall ensure that facilities or parts thereof are maintained, so that they are capable of carrying out their intended functions in all phases of their lifetime" and "facilities' systems and equipment shall be classified as regards the health, safety, and environment consequences of potential functional failures. For functional failures that can lead to serious consequences, the responsible party shall identify the various fault modes with associated failure causes and

failure mechanisms, and predict the likelihood of failure for the individual fault mode. The classification shall be used as a basis in choosing maintenance activities and maintenance frequencies, in prioritizing between different maintenance activities and in evaluating the needs for spare parts[52]."

- The Norwegian Petroleum Safety Authority (PSA) states that it ensures operator compliance with offshore regulations most frequently through dialogue. The PSA states, "The aim is not to punish or to create scapegoats, but to ensure that measures have been adopted to bring the enterprise's operations into compliance with the regulations...Our most frequently used response is dialogue. In most cases, written questions, phone conversations and meetings between the players and ourselves lead to measures being introduced which ensure that the enterprise complies with the regulations...Should an audit find minor infringements of the regulations, we always ask the player to explain how the nonconformity will be dealt with and set a deadline for a response."

Russia

According to Russian law, authorities collect data daily and perform statistical reporting on failures in addition to participating in the investigation causes of accidents and disasters.

The measures (procedures) for reporting equipment failure are published locally by the local authorities until they can be reviewed by central government authorities and published in the official register. For specific pieces of equipment, the first place to look would be the online register (in Russian). From these experiences, authorities develop measures to address the causes of such accidents and disasters in the future[53].

Russian authorities conduct inspections as they see fit to ensure compliance with mandatory requirements and conditions of offshore licenses. No specific frequencies or schedules were identified in the public domain. However, the regulatory body Rostekhnadzor does use scheduled and unscheduled audits to ensure compliance of applicable industrial safety laws for offshore operations. Additionally, the Federal Service for Supervision of Nature Use (Rosprirodnadzor) oversees compliance with legislation regulating subsoil use and protection of the environment. Additionally, the Federal Environmental, Industrial and Nuclear Supervision Service (Rostekhnadzor) issues mining allotments determining deposit boundaries, safety certificates and operating licenses.

Trinidad and Tobago

There are no identified provisions on equipment failure reporting systems in the offshore regulatory framework of Trinidad and Tobago.

United Kingdom

Incidents of equipment failure are required to be reported to the UK Health and Safety Executive (HSE) as part of the Reporting of Injuries, Diseases, and Dangerous Occurrences Regulations 2013 (RIDDOR). The regulation states: “All work-related accidents, diseases and dangerous occurrences in the UK and the Continental Shelf are required to be reported to the Health and

Safety Executive (HSE)." Reportable categories of dangerous occurrences for offshore installations are defined in Part 6 of the RIDDOR regulations and include "release of a petroleum hydrocarbon, fires or explosions, releases or escapes of dangerous substances, collapses, equipment failure, dropping objects, weather damage, collisions, subsidence or collapse of a seabed, loss of stability or buoyancy, evacuation, and falls into the water[54]." The incident site must remain undisturbed (except to be made safe) until HSE arrive to inspect, or give permission to disturb. HSE also operates a confidential website for anyone to raise a concern[55].

- In addition to RIDDOR requirements, under the Offshore Safety Case Regulations 2015, duty holders must also report to HSE: a) any major accident, or "situation where there is an immediate risk of major accident[56]," and b) for UK-based companies, any major accident occurring in non-UK operations.

- A Duty holder must appoint an independent organization as 'Verifier' of Safety Critical Elements (SCEs). The verifier is also known as an independent competent person (ICP). SCEs must have detailed Performance Standards (PSs). The Verifier must report performance failures to HSE. HSE also inspects to assure themselves that the initial verification scheme is suitable.

- The HSE states that "the verification scheme must examines the SCEs to ensure that they are suitable when brought into service…In addition during the lifetime of the installation, the suitability of SCEs needs to be reviewed particularly when known, technology or standards chance…For an SCE to be suitable it must perform as required (i.e. meet the specified performance standard). In order the achieve this, the duty holder and the ICP will need to be satisfied and be able to show that the SCE is: 1) suitably designed and constructed, and; 2) maintained in good repair and condition. Such as to achieve the required standard of performance, which itself needs to be kept up to date (following changed in knowledge, technology, circumstances, and re-assessment of risk, etc.[57]"

- An independent organization must also be appointed as a Well Examiner. Regulation 19 of the Offshore Safety Case Regulations requires the well operator to update HSE with progress data to an agreed schedule, and at least weekly.

United States

A general performance standard cited in the US regulations is: to "avoid failure of equipment that would have a significant effect on safety, health, or environment," a general performance standard listed in US regulations is that operators use of best available and safest technology (BAST) "whenever practical on all exploration, development, and production operations[58]."

There are requirements reporting systems in place for offshore equipment/operations failures in the US offshore regulatory framework; including for:

- Negative pressure testing of casings strings or liners: Section 250.423 states, "(5) If you have any indication of a failed negative pressure test, such as, but not limited to pressure buildup or observed flow, you must immediately investigate the cause. If your investigation confirms that a failure occurred during the negative pressure test, you must: (i) Correct the problem and immediately contact the appropriate BSEE District Manager; (ii) Submit a description of the corrective action taken and you must receive approval from the appropriate BSEE District Manager for the retest[59]."

- Cementing: Section 250.428 states, "if there is indication of an inadequate cement job…such equipment failure...operators must: 1. Run a temperature survey; 2. Run a cement evaluation log; or 3. Use a combination of these techniques[60]." Additional cementing requirements are presented in Section 250.1608, which states, "If there are indications of inadequate cementing (such as lost returns, cement channeling, or mechanical failure of equipment), the lessee shall evaluate the adequacy of the cementing operations by pressure testing the casing shoe. If the test indicates inadequate cementing, the lessee shall initiate remedial action as approved by the District Manager. For cap rock casing, the test for adequacy of cementing shall be the pressure testing of the annulus between the cap rock and the conductor casings. The pressure shall not exceed 70 percent of the burst pressure of the conductor casing or 70 percent of the collapse pressure of the cap rock casing[61]."

Equipment failure considerations/consequences are also addressed under U.S. CFR Title 30 Part 250.189, the following incidents under §250.188 require immediate notification to regulatory authorities and submission of a written report within 15 calendar days (1) All fatalities; (2) All injuries that require the evacuation of the injured person(s) from the facility to shore or to another offshore facility; (3) All losses of well control. "Loss of well control" means: (i) Uncontrolled flow of formation or other fluids. The flow may be to an exposed formation (an underground blowout) or at the surface (a surface blowout); (ii) Flow through a diverter; or (iii) Uncontrolled flow resulting from a failure of surface equipment or procedures; (4) All fires and explosions; (5) All reportable releases of hydrogen sulfide (H2S) gas, as defined in §250.490(l); (6) All collisions that result in property or equipment damage greater than $25,000; (7) All incidents involving structural damage to an OCS facility. "Structural damage" means damage severe enough so that operations on the facility cannot continue until repairs are made; (8) All incidents involving crane or personnel/material handling operations; (9) All incidents that damage or disable safety systems or equipment (including firefighting systems). Less severe accidents (outlined in Section 250.190) require written notification to the District Manager within 15 calendar days after the incident.

Venezuela

No significant provision regarding equipment failure reporting systems are identified in the Venezuelan regulatory framework. Article 16 of the Organic Law on Gaseous Hydrocarbons establishes that license and permit holders must emergency and contingency plans in place in order to minimize impacts to the environment and ensure the continuation of operations and services[62].

6.3 Accident Near Miss Reporting

Not all priority countries regulate accident near misses in their offshore frameworks. In priority countries which do regulate accident near misses, there is variation as to how accident near misses are defined according to a country's definition of an accident. In several priority countries accident near misses are defined as any events which may have led to specific accidents, which are specifically listed/described in regulations, such as injured personnel, pollution, and debilitating damage to the installation/equipment, while in others, operators are allowed to interpret accident near misses more broadly. From a regulatory perspective, specific accident near miss reporting requirements in conjunction with a broader reporting requirement are considered more informative for regulatory purposes than requirements for operators to report specified near miss accidents/incidents. In this way, offshore regulatory agencies can compile specified information for incidents with highest priority, as well as potentially identify new concerns with operator-reported information. An example regulatory clause which encourages increased operator reporting of near misses is in the Norwegian Management Regulations (Section 29) which outlines that "operators should immediately notify the Petroleum Safety Authority (by telephone)" in the event of hazard and accident situations that have led to, or under slightly altered circumstances could have led to: a) death; b) serious and acute injury; c) acute life-threatening illness; d) serious impairment or discontinuance of safety related functions or barriers, so that the integrity of the offshore or onshore facility is threatened; and e) acute pollution[63]." Under part d of this clause, operators have some room to interpret and report accordingly for "serious impairment or discontinuance of safety related functions or barriers."

All priority countries with accident near miss provisions generally require operators to submit oral notification and/or written follow up report(s) describing the accident and measures taken to address SHE concerns. Accident near miss reporting systems for priority countries, are described below. Note that there may be overlap in priority country regulatory provisions regarding accident near miss reporting where an accident/near miss may involve/be interpreted to involve equipment failure.

Australia

Accident near misses/other accidents and dangerous occurrences at or near facilities are reported to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) under Clause 82 of Schedule 3 to the Commonwealth Offshore Petroleum and Greenhouse Gas Storage Act 2006 and the relevant State and Northern Territory equivalents (except WA). Notification and reports of accidents and dangerous occurrences at or near facilities in Western Australian designated coastal waters should be made to the relevant State Minister through the WA Department of Mines and Petroleum. It is an offence of strict liability not to notify and report accidents and dangerous occurrences to NOPSEMA.

- Operators of offshore facilities are required to submit a written report within three days of the accident near miss, a final report (within 30 days of the incident) which includes a root cause analysis and actions taken to prevent recurrence of the same or similar incident with the responsible party and completion date, as well as a monthly

summary of incident information. The timing and format of this report are described in the Monthly Reporting Summary Guideline (GL0033).

Bahamas

Accident near miss reporting is not addressed in current Bahamian petroleum regulations. New regulations are being reviewed by the Bahamian government and Ministry of Environment and Housing and are anticipated to be issued in the near future. These regulations may potentially cover real time monitoring of accident near misses.

Brazil

Accident near miss reporting is not covered in Brazil statutory/regulatory offshore requirements. Accident/incident reporting is covered in ANP Regulation Number 44/2009, which establishes that all accidents must be reported to the ANP, including; incidents which cause damage to human health or the environment or any unscheduled interruption of operations for more than 24 hours.

Canada

Accident near miss reporting requirements are addressed in the Canadian offshore regulatory framework. The Nova Scotia and Newfoundland-Labrador Offshore Petroleum Boards must be "notified of any incident or near miss as soon as the circumstances permit."

- For any incidents or near-misses, a copy of an investigation report identifying the root cause, causal factors and corrective action taken is submitted to the Board no later than 21 days after the day on which the incident or near-miss occurred.

Separately, the Canada Oil and Gas Drilling and Production Regulations require that an operator's management system include "the processes for the internal reporting and analyzing of … near-misses and for taking correction actions to prevent their recurrence."

Cuba

There are no specific regulatory provisions, though the Cuban Safety Case guidelines released by the Cuban Office of Environmental and Nuclear Regulation (Oficina de Regulación Ambiental y Seguridad Nuclear (ORASEN), [based on International Association of Drilling Contractors 2006 guidelines], states that operators must provide information to ORASEN detailing criteria for identifying potential accidents as part of incident reporting and analysis procedures.

Denmark/Greenland

Denmark (though not Greenland) has near miss reporting requirements in its offshore regulatory framework. Actual incidents as well as near-miss injuries and incidents are reported to the Working Environment Authority (WEA) for occurrences including:

- 1) Any accident or death which occurred on the installation; 2) Near-miss incidents, including any discharges of oil; 3) Any significant damage to the offshore installation or equipment relating to health and safety; 4) Any near miss incident that could have resulted in death or accident; 5) Any escape of hydrocarbons that resulted in fire or explosion or had the potential to cause a major hazard; 6) Any incident where a person has been or is likely to have been exposed to ionizing radiation for more than the extent permitted by levels set by the Danish Health and Medicines Authority's order on health control at work with ionizing radiation; 7) Any incident that may have resulted in the release of a biological agent, and which may cause serious human infections or diseases; and 8) Any significant damage to the offshore installation's construction or safety or health equipment.

    - WEA reviews and assesses whether there should be taken some immediately measures. All reported injuries and near misses are reviewed offshore at the next supervision visit. The WEA usually inspects the site of accident in connection with an immediately report, usually with the police. The results of the WEA analysis and follow-up on selected events on Danish offshore installations 2002 - 2008 can be found in the yearly report of Denmark's Oil and Gas Production.

Iceland

There are no identified provisions on accident near miss reporting in the Icelandic offshore regulatory framework.

Jamaica

There are no identified provisions on accident near miss reporting in the Jamaican offshore regulatory framework.

Mexico

There are no provisions on accident near miss reporting in the Mexican offshore regulatory framework. The newly created regulatory agency, the National Agency for Industrial Safety and Environmental Enforcement, has administrative authority to establish reporting mechanisms for offshore operations, though the Agency has not issued any regulations subsequent to its establishment in August 2014.

Netherlands

Near miss accidents/incidents are required to be reported to the Dutch State Supervision of Mines.

As indicated in regulatory guidance, the following events must be reported to the State Supervision of Mines:

- "All important special events that have taken during transport activities, which endangered safety or were threatening to endanger safety," "situations in which the

safety was endangered in any kind of way or situation in which persons are or have been in life threatening situations," and "all incidents that have taken place during use, transport, or storage of explosive substances, which have endangered or could have endangered safety.[64]"

New Zealand

Provisions on accident near miss detection and reporting are covered in the New Zealand offshore regulatory framework. In general, the safety case and associated safety plans place the responsibility on the duty holder to report and handle situations related to failures and accident near misses. However, recently there has been a push to add more regulatory oversight to actively monitor these parameters.

- According to Regulation 78 of the Health and Safety in Employment (Petroleum Exploration and Extraction) Regulations 2013, "a duty holder must notify WorkSafe of any dangerous occurrence as soon as practicable after that occurrence becomes known to the duty holder." A dangerous occurrence includes near miss accidents; defined as the following: "an event that did not cause, but might have reasonably caused, a major accident[65]".

- The duty holder must provide to WorkSafe notification and supplementary information regarding the accident near miss; including, 1) written or oral notification of the occurrence to include identification of the location of the installation, time and date of the occurrence, a brief description of the occurrence, work or activity undertaken at the time of the occurrence, action taken to make the worksite safe, and whether an emergency response was initiated; and 2) a detailed written report of the occurrence (typically by 30 days after occurrence of the incident). It is the duty holder's responsibility to ensure compliance with the safety case. WorkSafe or regional councils may perform inspections to ensure compliance. Part of the responsibility of the independent third party "well examiner" is required to ensure compliance with standards[66].

Norway

Accident near miss reporting is covered in the Norwegian offshore regulatory framework.
The Management Regulations (Section 29) outline that operators should immediately notify the Petroleum Safety Authority (by telephone)

- "in the event of hazard and accident situations that have led to, or under slightly altered circumstances [near-accident] could have led to: a) death; b) serious and acute injury; c) acute life-threatening illness; d) serious impairment or discontinuance of safety related functions or barriers, so that the integrity of the offshore or onshore facility is threatened; and e)acute pollution[67]."

For less serious or acute incidents, the Petroleum Safety Authority requires operators to submit a written notification the first workday after the occurrence (Section 29 of Management Regulations). The Petroleum Safety Authority requires operators to keep the agency up to date on the status of hazards and accident situations.

Russia

There are no identified accident near miss reporting requirement in Russian offshore regulatory framework, though according to Russian law, authorities collect data daily and perform statistical reporting on failures in addition to participating in the investigation of causes of accidents and disasters. From these experiences, authorities develop measures to address the causes of such accidents and disasters in the future[68].

Trinidad and Tobago

There are no identified regulatory provisions for accident near miss reporting in the offshore regulatory framework of Trinidad and Tobago.

United Kingdom

Under the Reporting of Injuries, Diseases, and Dangerous Occurrences Regulations (RIDDOR) 2013 requirements, accident near misses are reported for categories of dangerous occurrences. For offshore installations, the regulations include reporting provisions for petroleum releases, fires and explosions, releases of dangerous substances, collapses, equipment failure, weather damage, collisions, and evacuations.

- In addition to RIDDOR requirements, under the Offshore Safety Case Regulations 2015, duty holders must also report to HSE: a) any major accident, or "situation where there is an immediate risk of major accident[69]," and b) for UK-based companies, any major accident occurring in non-UK operations. The UK Health and Safety Executive, states that "immediate risk of a major accident is a judgement made at the time given a number of factors, but the term is intended to convey an event which requires immediate physical action to regain control of the situation or to mitigate the consequences of a major accident (e.g. evacuation, shutting down a section of the plant or the entire installation, or stopping an activity)[70]."

United States

Accident near miss provisions in the U.S. offshore regulations are associated with monitoring and compliance for indications of equipment failure. Reportable accident near miss provisions are included in US regulations for well casing strings as well as during cementing operations (See Section 6.2). Accident near misses as a stand-alone category are not included in the list of reportable incidents in Section 250.186 of U.S. CFR Title 30.

Venezuela

There are no identified regulatory provisions for accident near miss reporting in the Venezuelan offshore regulatory framework.

7 Shallow and Deepwater Permitting and Monitoring

7.1 Introduction

Offshore operations initially began in shallow waters on fixed platforms in depths less than a hundred feet and onshore technology was effectively applied to drill for and produce hydrocarbons. With technological advancement, offshore operations expanded to deeper water with the use of innovative and increasingly complex technologies across the operational lifecycle of a well. Today, safe drilling and production can be achieved from subsea production systems and floating platforms at water depths up to several thousands of feet. In deep waters, increasingly complex technical and physical conditions, such as greater formation pressures and temperature, subsea, and metocean conditions, call for more sophisticated drilling/production facilities design and well control systems. For this report, upstream offshore operations are categorized as either shallow or deep, at a cutoff depth of 1,000 feet. Categorizations of offshore operations for priority countries are provided below in Table 9. Countries without current offshore production operations are uncategorized but may have offshore exploration operations.

Table 9: Priority Countries Shallow versus Deepwater Operation Characterization

Country / Req.	US	UK	NO	CA	MX	DK	IS	AU	RU	VE	CU	NZ	TT	NL	BR	JM	BS
Primarily deepwater operations? (> 1,000 ft.)			✓												✓		
Primarily shallow water operations? (<1,000 ft.)				✓	✓	✓				✓				✓			
Deep and shallow water operations	✓	✓	✓					✓	✓			✓	✓				

Many priority countries have active deepwater exploration and production operations, though each country varies in the mix. Historically exploration and production has moved from shallow towards deeper waters, but this is also influenced by national ocean topography. With few exceptions, the majority of nations do not have separate statutory/regulatory requirements for shallow and deepwater operations, so operators are expected to comply with all applicable regulations, regardless of water depth. Countries with specific statutory/regulatory requirements for both deep and shallow water operations include the United States and Mexico. Requirements

for these countries with respect to BOPs, cementing operations, and ROVs are presented in Sections 7.2.3, 7.3, and 7.4, respectively. The primary difference between Mexican and U.S. regulations, is that Mexican regulations currently task PEMEX (national oil company) with developing internal standards for these pieces of equipment/operations, whereas the United States details prescriptive requirements in offshore regulations.

Table 10 below provides a coverage overview of whether BOPs, cementing, and ROVs have specific shallow vs. deepwater requirements according to priority country regulatory documents. Checks indicate coverage of the topic in country statutory/regulatory provisions, and circles indicate no/very limited coverage of the topic.

Table **11** provides a qualitative and quantitative ranking of priority countries with respect to general criteria (e.g. quality of enforcement/enforcer) and specific criteria relevant to permitting (e.g. No distinction between shallow vs. deepwater regulations?). Input from industry SMEs in addition to research were used to provide the basis for comparing and contrasting each priority country. Qualitative Harvey Balls are used from a full ball (i.e. high quality) to a quarter ball (i.e. lower quality) where an empty ball indicates nothing is in place in the regulations. Following the tables are detailed definitions and specifications related to each priority countries' requirements as they relate to BOPs, cementing, and ROVs.

More details of priority country permitting and monitoring requirements for well control, cementing, and remote operated vehicles are documented in the appendix.

Table 10 - Overview of Shallow vs. Deepwater Permitting and Monitoring of Drilling

Requirement \ Country	US	UK	NO	CA	MX	DK	IS	AU	RU	VE	CU	NZ	TT	NL	BR	JM	BS
Blowout Preventers (BOP)																	
Shallow Water	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Deepwater	✓	✓	✓	✓	✓	○	✓	✓	✓	○	○	✓	✓	○	✓	✓	✓
Cementing Operations																	
Shallow Water	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Deepwater	✓	✓	✓	✓	✓	○	✓	✓	✓	○	○	✓	✓	○	✓	✓	✓
Remotely Operated Vehicles (ROV)																	
Shallow Water	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Deepwater	✓	✓	✓	✓	✓	○	✓	✓	✓	○	○	✓	✓	○	✓	✓	✓

Legend

✓	Covered in regulations
○	Not covered in regulations

Table 11 – Assessment of Shallow vs. Deepwater Permitting and Monitoring of Drilling Across Priority Countries

Country / Requirement	US	UK	NO	CA	MX	DK	IS	AU	RU	VE	CU	NZ	TT	NL	BR	JM	BS
Shallow vs. Deepwater																	
Country Ranking	3	2	1	6	9	12	7	4	11	14	15	5	13	10	8	16	17
Quality of Enforcement	◑	◑	●	◑	◔	◔	◔	◑	◑	◔	◔	◑	◔	◑	◑	◔	◔
Quality of Enforcer	◑	◑	●	◑	◔	◔	◔	◑	◑	◔	◔	◑	◔	◑	◑	◔	◔
No distinction	◑	●	●	●	◑	○	●	●	○	○	○	●	○	○	○	○	○

Legend

●	High Level of Quality	◔	Low Level of Quality
◑	Medium Level of Quality	○	Nothing in Place

7.2 Well Control/Blowout Prevention

7.2.1 Summary

Sustaining well control is a primary challenge in offshore operations and majority of priority country SHE regulations address minimization of the risk from well blowouts (uncontrolled flow of fluids from the well or wellbore). During drilling or workover operations, a blowout preventer[xii] (BOP) system is the most important equipment when a well needs to be closed immediately during major well control events. BOP systems ('stacks') are installed on the top of the casing head and typically consist of both ram and annular components. Annular components seal the space between the drill pipe and well bore, while rams cut through the drill string.

BOP preventer stacks are located either on the drilling/production installation (in shallow water operations, where the installation rests on the seabed) or subsea (for deeper water operations, where the installation floats). BOP systems for deepwater drilling operations are more sophisticated than those used in shallow waters, and include elements such as complex control systems and an increased number of rams. Additionally, testing and maintenance of deepwater BOPs can require significantly more time and effort. For maintenance of a subsea BOP system, the BOP has to be physically removed from the well and brought to the surface.

Priority country regulations address permitting/monitoring of blowout prevention through a variety of mechanisms and include a varying range of regulator body involvement. Some priority country regulators require submission of well management plans, or similar documents, while others address permitting/monitoring of blowout preventers under the general category of well-barriers. Many priority countries issue or reference specific prescriptive blowout preventer technical standards in their efforts to create robust requirements around BOPs.

7.2.2 Well Barriers and Well Operations Plans

Several priority countries do not address specific blowout preventer requirements, either in deep or shallow waters, and instead cite the performance requirement for operators to have a minimum number of well barriers in place during drilling/other offshore operations. In priority countries with performance-based regulatory frameworks, well barriers are primarily defined in national legislation as a general term which covers the full well lifecycle. For example, in Canada, well barriers are not specific in regulations, with the exception of during drilling operations, where (not counting under-balanced drilling), the Canada Oil and Gas Production Regulations state, "one of the two barriers to be maintained is the drilling fluid column." For all other operations barriers are not specified and the term "barrier" is defined as "any fluid, plug, or seal that prevents gas or oil or any other fluid from flowing unintentionally from a well or from a formation into another formation[71]." The United Kingdom and Norway are also two countries which utilize a performance-based approach to define and regulate well barriers. In the United Kingdom, operators are required to report to regulators describing how the well barriers in place

[xii] BOP systems may include one or more connected individual BOPs or Christmas trees and associated subsurface safety valves (SSSV)

are "suitable for all anticipated conditions and circumstances[72]." In the UK, descriptions of well barrier operations are expected to be included in SEMS and in well operations plans submitted to offshore regulators. For well operations, the UK HSE states that information submitted regarding well operations should include "the sequence of operations which can reasonably be foreseen, emphasizing details of the safety-related steps, such as casing/tubing pressures tests, formation integrity tests, cementing/cement tops, blow out preventer function and pressure tests and barrier inflow and pressure tests[73]." Similar to Canada, industry guidance is published by Oil and Gas UK (OGUK), which states that at least two barriers should be in place throughout the well lifecycle at an installation.

In these examples of countries with goal-based regimes where prescriptive well barriers standards are not defined in offshore oil and gas regulations, legislation is typically supplemented by various industry guidance in technical standards and legal guidance by the regulator on the various types of well barriers and how they should be designed, assured/tested in situ, and maintained throughout the well lifecycle. In the industry, the term well barrier describes operational equipment/objects which prevent flow of fluids out of a reservoir/well. Example well barriers include drilling mud, Christmas trees, blowout preventers (BOPs), the well casing, and cement. This more goal-based approach gives operators flexibility in determining appropriate BOP system specifications to achieve the proper well control.

In general, the better operators and contractor personnel understand BOP systems and the function of other associated well barriers, the lesser risk for severe incidents/accidents related to potential barrier malfunction. If a BOP system is to be used at a facility during an event, site-specific performance standards and design, as well as high quality personnel training/competency at any given time, are main factors determining the efficacy of accident/incident response procedure(s). Priority country regimes may also require submission and approval of permits and plans associated with drilling operations specific to well control or particular pieces of equipment such as safety critical elements. Alternatively, countries may require a more comprehensive approach to permitting/monitoring offshore operations and require submission and approval of an overarching safety case. These submitted plans inform offshore regulators of anticipated operations at a well installation and may allow for regulatory participation in deciding particular measures for well control and blowout prevention specifications or considerations.

Canada is also an example priority country whose regulations reference barriers to ensure well control in offshore operations. Part 4, Article 36 of the Canada Oil and Gas Drilling and Production Regulations states "the operator shall ensure that, during all well operations, reliably operating well control equipment is installed to control kicks, prevent blowouts and safely carry out all well activities and operations, including drilling, completion, and workover operations". Additionally, subsequent to setting the surface casing, "the operator shall ensure that at least two independent and tested well barriers are in place during well operations." Well barriers are tested in situ after completion "to the maximum pressure to which they are likely to be subjected[74]."

7.2.3 Blowout Preventer Permitting and Monitoring Requirements

Offshore regulators in the majority of priority countries do not separately permit/monitor offshore drilling operations in shallow versus deep waters. Subsea BOPs refer to BOPs installed in deep waters, whereas in shallow waters, surface BOPs are installed on shallow water platforms. Nations with requirements for BOPs in regulatory frameworks include Cuba, Denmark/Greenland, Mexico, the Netherlands, Norway, the United Kingdom, and the United States. Descriptions of permitting/monitoring activities with respect to blowout prevention in the aforementioned countries are provided below along with the following designation:

- Green checkmark indicates the priority country has specific deepwater requirements in their regulations for permitting/monitoring of shallow vs. deepwater operations.
- Red x's indicates that the priority country does not have specific requirements for deepwater operations.

Cuba – ☒

The Cuban regulatory framework is based on the International Association of Drilling Contractors "Health, Safety, and Environment Case Guidelines for Mobile Offshore Drilling Units" and requires specific BOP system characteristics including pressure ratings and affirmation of BOP system design according to API standards are included in the safety case for drilling operations.

Denmark/Greenland – ☒

- All offshore operations in Denmark take place in shallow waters.
- The offshore regulator, the Working Environment Authority (WEA), requires submission of BOP preventer system specifications by operators in a "Drilling Programme," including:
  - A list of blowout prevention equipment located on the platform (specifying manufacturer, size, working pressure, and arrangement), information on the BOP control system; and " a list of the blowout prevention equipment available on the drill floor ready for mounting on the drill pipe[75]."
  - Kick control procedures ("the data and calculations which by routine are updated to ensure the necessary background for handling emergency situations,") and information on how BOPs, measurement equipment, and drilling fluid circulation and mixing equipment will function under conditions creating a kick.
  - A "programme for drills in connection to the equipment".
  - A testing program for blowout preventers and casing at different stages of drilling operations. Blowout preventer set-up specified by the WEA includes installation of the blowout preventer prior to installation of the surface casing.

In Greenland, BOP system requirements are outlined in the Greenland Bureau of Minerals and Petroleum Drilling Guidelines.

- The Guidelines state that BOP systems must consist of a minimum of "two pipe shear rams, comprising 1 blind shear and 1 casing shear ram." Additional blowout preventer system

guidance states "the control BOP Control System shall in addition to the regulator control system of a Remotely Operated Acoustic Control System for emergency situations."

- On mobile offshore drilling units (MODUs), the BMP also states that "dependent on the age, state of conditions, historical and maintenance records among others, BMP may request a full third party review and reassessment of the complete Well Control System onboard the MODU prior to commencement of drilling operations."
- A drilling program submitted to the BMP must also contain
    1. List of BOP equipment available at a MODU (including manufacturer, size, pressure and arrangement);
    2. Procedures for kick control and how BOP equipment will respond to these conditions;
    3. Description of drilling procedures with BOP equipment; and
    4. Description of the program for pressure testing BOP and casing at different stages in drilling operations. Disassembly or maintenance of blowout preventers can only occur when the well is secured by two independent and tested barriers, generally or specifically accepted by the BMP.

Mexico – ☑

- Statutory/regulatory requirements establish that PEMEX must have internal standards for blowout preventer equipment used in deepwater operations.
- National Hydrocarbon Commission Resolution 12.001/10, Article 46, Section IX, states PEMEX must have internal standards for Blowout Preventers which incorporate industry best practices for testing Blowout Preventers during drilling, well testing, completion, and well repair and work over activities[76].
- Article 46, Section IX, subsections a-g also provide additional specifications regarding blowout Preventer design standards and monitoring, including having remotely operated vehicles with capabilities to operate all subsea control systems, establishing verification protocols for proper operation and sealing of blowout preventers, well pressure testing, reviewing existing standards, verifying manufacturers follow the latest standards, verifying new elements in blowout preventer design increase reliability and safety, and proper design of blowout preventer arrangement.
- Article 46, Sections XI-XIII also provide further specifications for Blowout Preventers, including equipment performance, maintenance, and personnel training. Regulatory designations include mandatory internal procedures and mechanism for third party testing (Section XI, subsection d); process for inspection and certification of blowout preventers every five years (Section XI, subsections a-e); and a training program (Section XIII).

Netherlands – ☒

Prescriptive well control/blowout preventer system requirements are outlined in Articles 8.3.1.2 through 8.3.3.2 of the Mining Regulation; including blowout prevention system equipment; operation procedures, and testing requirements and guidelines[77].

Norway – ☒

Norwegian regulations include limited prescriptive elements regarding blowout preventer systems. Well control performance standards are addressed in Chapter VIII of the Norwegian Facilities Regulations (Section 49).

Regarding well control equipment, the regulations state, "[it] shall be designed and capable of activation such that it ensures both barrier integrity and well control. For drilling of top hole sections through risers or conductors, equipment shall be installed with a capacity to divert shallow gas and formation fluids away from the facility until the personnel have been evacuated. The pressure control equipment used in well interventions shall have remote-controlled valves and mechanical locking mechanisms in the closed position. Well intervention equipment shall have a remote-controlled shear/blind ram as close to the Christmas tree as possible. Floating facilities shall have an alternative activation system for activating critical functions on the blowout preventer for use in the event of an evacuation. Floating facilities shall also have the capacity to disconnect the riser package after the shear ram has cut the work string[78]."

United Kingdom– ☒

Blowout preventers are considered safety critical elements to be described in a Safety Case submitted to the UK HSE. Schedule 7, item 12 of 2015 OSC Regulations, states that for pressure control and to prevent the uncontrolled release of hazardous substances, operators must submit "particulars of the plant and arrangements for control[79]."

United States – ☑

Blowout preventer requirements are outlined in Sections 250.440-451[80]. The US regulations contain general and more prescriptive requirements for all BOP systems as well as specifications solely for subsea (deepwater) BOPs. The overall performance requirement for BOP systems in US regulations is that an operator must "design, install, maintain, test, and use the BOP system and system components to ensure well control." For drilling operations, the following requirements apply to subsea BOPs (Section 250.442):

- At least four remote-controlled, hydraulically operated BOPs;
- Operable dual-pod control system to ensure proper and independent operation of the BOP system;
- Accumulator system to provide fast closure of BOP components and to operate all critical functions in case of a loss of the power fluid connection to the surface;
- Subsea stack equipped with remotely operated vehicle (ROV) capability;
- Provision of autoshear and deadman systems for dynamically positioned rigs;
- Heave operational or physical barrier(s) on BOP control panels to prevent accidental or unplanned disconnects of the system;
- Clearly label all control panels for the subsea BOP system;
- Develop and use a management system for operating the BOP system, including prevention of accidental or unplanned disconnects of the system;
- Establish minimum requirements for personnel authorized to operate critical BOP equipment.

For surface BOPs, the following requirements apply (Section 250.441)[81]:

- BOP system must be installed before drilling below the surface casing.
- Surface stack must include at least four remote-controlled, hydraulically-operated BOPs, consisting of an annular BOP, two BOPs equipped with pipe rams, and one BOP equipped with blind or shear rams. The blind shear rams must be capable of shearing the drill pipe that is in the hole.
- Accumulator system must be installed that provides 1.5 times the volume of fluid capacity necessary to close and hold all BOP components. The system must perform with a minimum pressure of 200 psi above the precharge pressure without assistance from a charging system. If you supply the accumulator regulators by rig air and do not have a secondary source of pneumatic supply, you must equip the regulators with manual overrides or other devices to ensure capability of hydraulic operations if rig air is lost.

7.3 Cementing Operations

Cementing is an important component of offshore wells, serving as the primary external seal between the formation and conductor casing. Cement barriers are installed at the bottom of each casing string (including surface, intermediate, and production) and pressure tested before starting on the next section of the well. Pressure tested cement is a continuously functioning well barrier which does not require any external action for sufficiency, such as blowout preventer initiation procedures. Generally, priority countries do not have separate statutory/regulatory requirements for permitting/monitoring of cementing operations in shallow vs. deep waters, such as cement type, volume, pumping placement, or performance monitoring. Statutory/regulatory priority country cementing requirements are listed below. Green checkmarks or red x's indicate whether or not the nation has specific cementing requirements to permit/monitor shallow and vs. deepwater operations.

Australia – ☒

Performance-based guidance on cementing operations is identified in the Australian regulatory framework. Operators are required to submit a WOMP to the National Offshore Safety and Environmental Management Authority (NOPSEMA) for acceptance as well as submit a copy to the National Offshore Petroleum Titles Administrator (NOPTA). NOPSEMA states, "a WOMP should demonstrate that there is a system in place to manage well integrity and well activities for the life of the wells. A WOMP should also include a description of the design, construction, and management of the well activities and a plan for managing the risks associated with the activities in accordance with sound engineering principles and good oil field practice." A WOMP remains valid for 5 years. An initial well completion report is due to the Title Administrator containing information on cementing operations and schematics for well abandonment.

Bahamas – ☒

There is no significant permitting/monitoring of cementing operations in the Bahamian petroleum regulatory framework. Article 41 of the Bahamian Petroleum Regulations covers cementing of casing strings in offshore drilling and development operations. The Article states, "Sufficient casing strings shall be run and cemented in all wells so as to protect adequately against the contamination of water, to provide a secure base for blowout prevention equipment and to prevent interchange of formation fluids."

Brazil – ☒

No prescriptive cementing requirements are addressed in the Brazilian regulatory framework. According to the definition provided in the Brazilian Operational Safety Management System (Regulation Number 43/2007), cementing operations are considered safety critical elements of an offshore installation.

Canada – ☒

Several elements regarding cement design/placement considerations are included in the Canada's Oil and Gas Drilling and Production Regulations. These considerations are listed below.

- "The operator shall ensure that the well and casing are designed so that the well can be drilled safely, the targeted formations evaluated and waste prevented; the anticipated conditions, forces and stresses that may be placed upon them are withstood; and the integrity of gas hydrate and permafrost zones."

- "The operator shall ensure that the well and casing are installed at a depth that provides for adequate kick tolerances and well control operations that provide for safe, constant bottom hole pressure."

- "The operator shall ensure that cement slurry is designed and installed so that the movement of formation fluids in the casing annuli is prevented and, where required for safety, resource evaluation or prevention of waste, the isolation of the oil, gas and water zones is ensured; support for the casing is provided; corrosion of the casing over the cemented interval is retarded; and the integrity of gas hydrate and permafrost zones — and, in the case of an onshore well, potable water zones — is protected."

- "After the cementing of any casing or casing liner and before drilling out the casing shoe, the operator shall ensure that the cement has reached the minimum compressive strength sufficient to support the casing and provide zonal isolation. After installing and cementing the casing and before drilling out the casing shoe, the operator shall ensure that the casing is pressure-tested to the value required to confirm its integrity for maximum anticipated operating pressure."

Cuba – ☒

Cementing system reporting/documentation requirements are addressed in Part III of the 2010 regulation: "Preparation of Safety Case Reports for Offshore Oil/Gas Well Drilling

Installations." Cement system items to be included in the health, safety, and environment (HSE) case are: a description (with rating/capacities) and relevant standards for cement unit interfaces, a line drawing of the cement system, and arrangements for reviewing/approving the status/condition of 3rd party cement units.

Denmark/Greenland – ☒

In Denmark, cementing operations activities and reporting requirements (irrespective of deep and shallow water classification) are addressed in a Drilling Programme: specifications/guidance topics addressed include performance of a cement hardening test, cement specification for casing placement (including cement type and volume), cement bond logging and temperature surveys, and cement plugging for well abandonment activities.

Greenland's Bureau of Minerals and Petroleum (BMP) issues requirements/guidance on cementing operations in its Exploration Drilling Guidelines. Guidance includes that cement bond logs or temperature surveys are performed when critical tops of cement (TOCs) are required for intermediate and production casing isolation and production casing and liners are checked with cement bond logging in circumstances where an incomplete job is suspected. The BMP also issues requirements on cementing operations as part of suspension/abandonment operations, including cement placement and weight.

Iceland – ☒

No cementing operations permitting/monitoring requirements/guidance addressed in Iceland's statutory/regulatory offshore petroleum framework. The regulator (National Energy Authority) regulates cementing operations through performance-based guidelines and through review and approval of field development and production plans.

Jamaica – ☒

No cementing operations permitting/monitoring requirements/guidance addressed in the Jamaica's statutory/regulatory petroleum framework.

Mexico – ☑

Statutory/regulatory requirements establish that PEMEX must have internal standards for cementing operations in deep waters. In Mexico, the National Hydrocarbon Commission Resolution 12.001/10, Article 46, Section XIV states that PEMEX must have an internal regulation for mechanisms and procedures for items including evaluation of cement quality and integrity tests (especially with respect to exposure to high temperature and pressure), as well as best techniques for cement qualitative and quantitative evaluation[82].

Netherlands – ☒

No extensive cement reporting requirements/specifications are addressed in Dutch petroleum regulations, though in the "Work Programme for construction of boreholes," operators must provide "details of the cementing of each casing series to be applied, with details of the planned

depth from the top of the annular cement column." (Article 8.2.1.1 of the Dutch Mining Regulation). The work programme is required to be submitted to the State Supervision of Mines at least 4 weeks prior to commencement of well operations. Cementing operations are also considered in separate reports for well repair and decommissioning, titled, respectively, "work programme for the repair of wells" and "work programme for decommissioning of wells." Required details to be included in these reports are "details of the cementing of each casing series to be applied, with details of planned depth from the top of the annular cement column [well repair]." and drawings of "cementing depth and depth to the top of the annual cement columns [well decommissioning] (Mining Regulation Articles 8.2.3.1 and 8.2.4.1)[83]."

New Zealand – ☒

New Zealand follows a safety case regime and do not have specific regulations/requirements governing Cementing Operations. A certificate of fitness is issued for each offshore installation with an approved safety case. Certificates of fitness verify compliance with a safety case and "demonstrate that the installation's structure and all equipment necessary for the safe operation of the installation are appropriately designed, are in good working order and in a good state of repair." "An installation's safety case will list all structures and equipment required for the safe operation of the installation." A certificate of fitness is valid for five years, and it must be re-issued after five years by a recognized inspection body. "If the structure or equipment required for an installation's safe operation no longer complies with its existing certificate of fitness, the duty holder must cease operation of all the affected structure or equipment[84]." "When the duty holder modifies or replaces part of all of the installation's structure or equipment necessary for its safe operation, including software revisions for programmable devices, the installation's certificate of fitness is no longer current," and a new certificate of fitness must be issued by an inspection body.

Norway – ☒

Performance-based cementing requirements are addressed in regulatory provisions on well barriers in the Norwegian regulatory framework. Additional prescriptive requirements are addressed in standard, such as NORSOK Standard D-010[85]. Regulator references to well barrier provisions are listed below:

- Section 85 of the Norwegian Activities Regulations states, “During drilling and well activities, there shall be tested well barriers with sufficient independence, cf. also Section 48 of the Facilities Regulations.
    - If a barrier fails, activities shall not be carried out in the well other than those intended to restore the barrier.
    - There shall be pumping and fluid capacity available on the facility or on vessels in the event of heavy well intervention. The need for pumping and fluid capacity in the event of light well intervention shall be included in the activity-specific risk assessment.

- When handing over wells, the barrier status shall be tested, verified and documented[86].”

- Section 48 of the Facilities Regulations provides well barrier performance-based guidelines; these are listed below:

  - “Well barriers shall be designed such that well integrity is ensured and the barrier functions are safeguarded during the well's lifetime;
  - Well barriers shall be designed such that unintended well influx and outflow to the external environment is prevented, and such that they do not hinder well activities;
  - When a production well is temporarily abandoned without a completion string, at least two qualified and independent barriers shall be present;
  - When a well is temporarily or permanently abandoned, the barriers shall be designed such that they take into account well integrity for the longest period of time the well is expected to be abandoned;
  - When plugging wells, it shall be possible to cut the casings without harming the surroundings;
  - The well barriers shall be designed such that their performance can be verified[87].”

- Additional performance-based well barrier design requirements are addressed in Section 5 of the Management Regulations, which states, “Barriers shall be established that at all times can:

  - Identify conditions that can lead to failures, hazard and accident situations;
  - Reduce the possibility of failures, hazard and accident situations occurring and developing;
  - Limit possible harm and inconveniences.”

- Section 5 of the Management Regulations further states, “where more than one barrier is necessary, there shall be sufficient independence between barriers. The operator or the party responsible for operation of an offshore or onshore facility, shall stipulate the strategies and principles that form the basis for design, use and maintenance of barriers, so that the barriers' function is safeguarded throughout the offshore or onshore facility's life. Personnel shall be aware of what barriers have been established and which function they are intended to fulfill, as well as what performance requirements have been defined in respect of the concrete technical, operational or organizational barrier elements necessary for the individual barrier to be effective. Personnel shall be aware of which barriers and barrier elements are not functioning or have been impaired. Necessary measures shall be implemented to remedy or compensate for missing or impaired barriers[88].”

- Cementing unit performance standards are addressed in Chapter VIII, Section 52 of the Norwegian Facilities Regulations. This section states, "The cementing unit shall be designed such that it mixes, stores, and delivers the correct volume of cement with necessary properties to ensure proper anchoring and barrier integrity. The unit shall be designed such that the residues of both unmixed chemicals and mixed cement are handled in accordance with the principles of the Pollution Control Act (in Norwegian only). In the event the cementing unit with associated systems shall function as a replacement unit for the drilling fluid system, it shall have sufficient capacity and working pressure to be able to control the well pressure at all times[89]."

Russia – ☒

There is no distinguishing made between cementing operations requirements in shallow vs. deepwater based on information in the public domain.

Trinidad and Tobago – ☒

No cementing operations permitting/monitoring requirements/guidance addressed in Trinidad and Tobago's statutory/regulatory petroleum framework.

United Kingdom – ☒

Cementing requirements are covered in Section 4.3 of the HSE Well Construction Standards Technical Guide. These standards are listed below, quoted directly from the Guide[90]:

- "All hydrocarbon bearing zones should be isolated from surface. For all cementing operations, whether primary, remedial or plugging, the cement should be placed and checks carried out to ensure that the cementing objectives are achieved."
- "The quantity of cement must be suitable for the proposed operation in question. All conductors and surface casing should normally be cemented back to mud-line. Intermediate and production casing should, where appropriate, be cemented back to previous casing shoe and preferably back to mud-line for shallow strings (see exception below). Production casing should, where appropriate, be cemented to an acceptable height inside the previous shoe. A prudent excess is required to account for possible losses during placement and variation in diameter of open hole."
- "Exceptions to the requirement for cementing back to the previous casing shoe are:
  - where it precludes a later well sidetrack;
  - in a subsea well where the casing annuli cannot be bled down (i.e. for thermal expansion where the leak-off gradient in the open hole beneath the casing shoe provides a pressure limit);
  - to prevent losses or break-down of weak formations;
  - cuttings injection down a well annulus."

- "The density of cement must be suitable for the proposed operation in question. The formations should be capable of withstanding the hydrostatic head of the cement column.

Primary well control must be maintained while the cement is curing. Cement slurry density and spacer fluid should be sufficient to prevent any influx of well fluids."

- "The class of cement must be suitable for the proposed use; the slurry should be compatible with formation to be cemented and with anticipated temperature conditions."

- "Cement evaluation logs for verification of cement bonding are considered good practice for production casing and intermediate casing strings covering hydrocarbon bearing zones."

Cementing operations are considered safety critical elements (SCEs) in the UK's safety case regime. All SCEs are identified in the safety case and duty holders (installation owners/operators) must appoint an independent organization as "Verifier" of SCEs. A Verification Scheme, or document ensures SCEs at an installation are suitable, or appropriate for intended use, dependable and effective when required, and able to perform as intended. The Verification Scheme should provide independent review/inspection to establish continued effectiveness throughout an installation's lifecycle, and be updated when industry standards/technology/knowledge change; it must be shown that all SCEs are suitably designed/constructed and will be properly maintained. Safety Critical Elements must have detailed Performance Standards (PSs), defined as "a statement, which can be expressed in qualitative or quantitative terms, of the performance required of a system, item of equipment, person or procedure, and which is used as the basis for managing the hazard, e.g. planning, measuring, control, or audit - through the lifecycle of the installation[91]."

United States – ☑

There are a number of prescriptive requirements for cementing operations in the United States regulatory framework[92]. All wells must be cemented according to guidelines established in U.S. CFR Title 30, Subpart D, Sections 250.420-428. Section 250.421 provides cementing requirements by casing type for offshore operations, specifying items such as cement amount and placement[93]. Section 250.422 prescribes when drilling operations may resume after cementing. This portion of the regulation states, "After cementing surface, intermediate or production casing (liners), you may resume drilling after the cement has been held under pressure for 12 hours. For conductor casing, you may resume drilling after the cement has been held under pressure for 8 hours." Section 250.428 outlines what actions (including surveys and tests) must be performed if certain situations are encountered with respect to cementing operations; including: indication of an inadequate cement job, failure of a primary cement job to isolate abnormal pressure intervals, needing to use less cement than required for surface operations during floating drilling operations, and cementing across a permafrost zone.

Venezuela – ☒

No cementing operations permitting/monitoring requirements/guidance addressed in Venezuela's statutory/regulatory petroleum framework.

7.4 Remotely operated Vehicles

Remotely operated vehicles (ROVs) are underwater robots which fall under two classes: inspection and work class. Inspection ROVs are primarily used for underwater surveillance while work class ROVs are mechanical arms with a wide range of underwater capabilities. ROVs are manipulated by trained operators who maneuver the machinery with a joystick in a control room. In the offshore industry, ROVs are used more frequently in deepwater than shallow water operations (because divers cannot work in deepwater) and provide functions including subsea surveillance and performance of specialty subsea construction, repairs, and infrastructure maintenance. For subsea trees installed in deep waters, ROVs are critical for reliable and safe operations, performing duties such as turning valves and installed control lines, and providing visual evidence of system performance. On fixed platforms installed in shallow waters, ROVs do not serve as critical a function, because equipment is accessible on the surface of the platform. The majority of priority countries do not include specific requirements regarding the use of remotely operated vehicles in either shallow or deep waters. However, where an ROV may be required to operate as part of a safety-critical element (SCE) defined in a safety case (e.g. to operate backup valves on a deepwater subsea BOP as part of blowout emergency response), the required performance standards (technical plus reliability/availability) for that ROV would form part of the overall performance standards for that SCE.

The United States and Mexico are the only priority countries which separately regulate the use of ROVs in deepwater. For priority countries with regulatory ROV requirements, descriptions are provided below. Green checkmarks or red x's indicate whether or not the nation takes specific deepwater permitting/monitoring requirements.

Cuba – ☒

Operator ROV monitoring requirements are addressed in Part III of the 2010 regulation: "Preparation of Safety Case Reports for Offshore Oil/Gas Well Drilling Installations." Section 3.10 of the regulation states that operators should reference the procedures for reviewing/approving the status/condition of 3rd party ROV units, as well as a description of any risk assessment performed.

Mexico – ☑

National Hydrocarbon Commission Resolution 12.001/10, Article 46, Section XVI, states PEMEX should have mechanisms and procedures in place for ROVs, for items including: selection of appropriate ROVs, evaluation of use of ROVs in emergencies and contingencies, personnel training in ROV use, and third party certification of ROVs[94].

United States – ☑

The United States has ROV requirements for drilling operations, associated with subsea blowout preventer stack (used in deep waters) testing, maintenance, and drills. The ROV requirements are provided in Section 250.442 of U.S. CFR Title 30[95]. This section states "when drilling with a subsea BOP system, you must":

- Have a subsea BOP stack equipped with remotely operated (ROV) intervention capability. Additionally, the ROV must be capable of closing one set of pipe rams, closing one set of blind shear rams and unlatching the lower marine riser package (LMRP).

- Maintain a ROV and have a trained ROV crew on each drilling rig on a continuous basis once BOP deployment has been initiated from the rig until recovered to the surface. The crew must examine all ROV related well-control equipment (both surface and subsea) to ensure that it is properly maintained and capable of shutting in the well during emergency operations. Additionally, the crew must be trained in the operation of the ROV. The training must include simulator training on stabbing into an ROV intervention panel on a subsea BOP stack.

Additional ROV requirements for testing subsea BOP stacks are outlined in Section 250.449. These include:

- Test all ROV functions on subsea BOPs during stump tests, test verify closure of at least one set of rams during the initial test on the seafloor through an ROV hot stab, and submit testing procedures along with an Application for Permit to Drill to the BSEE District Manager. It must be ensured that ROV hot stabs "are function tested and capable of actuating, at a minimum, one set of pipe rams, one set of blind shear rams, and unlatching the LMRP96."

The US regulations also include ROV requirements after a well has been plugged or a facility has been removed. Section 250.1740 states "within 60 days after you permanently plug a well or remove a platform or other facility, you must verify that the site is clear of obstructions by using one of the following methods," including "videotape the site using a camera on a remotely operated vehicle (ROV)." Section 250.1742 also includes a provision that ROVs can be used to verify a former site is clear of obstructions (if the site is not cleared using a trawling vessel). ROV operators must "ensure that the ROV camera records videotape over 100 percent of the appropriate grid area" and "ensure that the ROV uses a pattern of concentric circles or parallel lines spaced no more than 10 feet apart[97]."

8 Drilling and Production Activities Inspection Program

8.1 Inspection Program Overview

Oversight of drilling and production operations through an inspection program is a critical function of any regulatory body when operating offshore. On one hand, it allows the regulator to check as they wish to ensure all phases and aspects of operations are consistent with the agreed requirements, regardless of whether it's a performance based or prescriptive regulatory regime. Such monitoring can determine whether an operator has the right management systems in place, whether the safety case is being followed, or whether a prescriptive requirement related to BOPs is adhered to. Regardless of the situation, workplace inspections from the regulating body are a key element of any successful regime geared towards improving offshore operations. On the other hand, an inspection program also allows the regulator to gain some level of comfort and experience by going out into the field and monitoring activities and people, rather than just the paper submissions available in the office.

An inspection program can be characterized using various parameters such as the training of inspection personnel, equipment and operations inspected, the frequency of inspections, notifications of non-compliance, enforcement tools that may be available to regulators, how often they are used, and so on. Typically, the more safety/health/environmentally-critical an equipment item or operation is, the more thorough will be the associated inspection program. This may be achieved either through increased frequency of inspections (although sometimes random) or increasingly severe repercussions for instances of non-compliance. This approach underpins a focus on well pressure control equipment in many the countries where, for example, BOPs (equipment level) are often required to be inspected in detail, in addition to the more general inspections of drilling rigs (facility level).

However, whether the overall regulatory regime is prescriptive or performance based will typically determine how specific these inspection requirements are across priority countries. For example, in the U.S., there are some very specific requirements that must be carried out as part of the regulator's inspection program for specific equipment/systems (e.g. drilling and production facilities) with strict rules on recording and documenting the findings. Countries with more of a performance based approach will have, on average, a less specific inspection program requirements, with much of the focus being on verifying that the operator is performing what was actually stated in their safety case. Inspections are randomly performed for offshore installations, though installations may be prioritized for inspection based on criteria such as performance and compliance history, prior incidents/accidents, and operational characteristics/industry incident trends prioritized by the regulatory bodies. All equipment and operations described in an operator's safety case are prioritized for inspections by regulatory bodies, ensuring safety critical functions are given priority. One example of distinction in terms of regulatory approach to an inspection program is in Brazil. Since Brazil's offshore regulatory regime is built upon 17 management system principles, regulatory authorities use these principles to effectively drive their inspection program. Similar to the way regulators analyze a

safety case and prioritize their inspection plan based on the written safety case, Brazilian regulators use the 17 elements of the safety management system to drive their inspection plan.

Table 12 below provides a coverage overview of drilling and production activities through the inspection program requirements according to priority country regulatory documents. Checks indicate coverage of the topic in country statutory/regulatory provisions, and circles indicate very limited coverage of the topic. Table 13 provides a qualitative and color-coded quantitative ranking of priority countries with respect to general criteria (e.g. quality of enforcement/enforcer) and specific criteria relevant to inspections (e.g. Are inspection findings widely publicized?). Input from industry SMEs in addition to research were used to provide the basis for comparing and contrasting each priority country. Qualitative Harvey Balls are used from a full ball (i.e. high quality) to a quarter ball (i.e. lower quality) where an empty ball indicates nothing is in place in the regulations.

Following the table are sections describing further detail for specific sub-tasks and priority countries.

Table 12: Priority Country Comparison of Drilling and Production Activities Inspection Programs

Country / Requirement	US	UK	NO	CA	MX	DK	IS	AU	RU	VE	CU	NZ	TT	NL	BR	JM	BS
Inspection Program																	
Training of Inspection Personnel	○	○	✓	✓	○	○	○	○	✓	○	○	✓	○	○	○	○	○
Equipment and Operations Inspected	✓	✓	✓	✓	○	✓	○	✓	✓	○	✓	✓	✓	✓	✓	○	✓
Frequency of Inspections	✓	✓	✓	✓	○	○	✓	✓	✓	○	○	✓	○	✓	○	○	✓
Notification of Non-Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	○	✓	✓	○	✓	✓	○	○
Enforcement Tools Available and Used (e.g. INCs, Shut-in orders, etc.)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Legend

✓	Covered in the regulation
○	Not covered in the regulation

Table 13 – Assessment of Drilling and Production Activities Inspection Programs Across Priority Countries

Requirement \ Country	US	UK	NO	CA	MX	DK	IS	AU	RU	VE	CU	NZ	TT	NL	BR	JM	BS
Inspections																	
Country Ranking	4	2	1	7	12	8	10	3	11	15	14	6	13	5	9	16	17
Quality of Enforcement	◑	◑	●	◑	◔	◑	◑	◑	◔	◔	◔	◑	◔	◔	◑	◔	◔
Quality of Enforcer	◑	●	●	●	◔	◑	◔	●	◑	◔	◔	◑	◔	◔	◑	○	○
Findings widely Publicized	◑	◑	●	○	◔	◔	○	◑	○	○	○	◑	○	◑	◔	○	○
Accident information widely shared	◑	●	●	○	○	◔	○	◑	○	○	○	◔	○	◑	○	○	○

Legend

●	High Level of Quality	◔	Low Level of Quality
◑	Medium Level of Quality	○	Nothing in Place

8.2 Training of Inspection Personnel

In the majority of priority countries, training of regulatory inspection personnel is not addressed in statutory regulations. A few notable exceptions are:

Russia – Training of inspection personnel should be provided by an authorized/licensed company every 2, 3, and 5 years[98]. These are followed by annual checks.

Norway – Section 65 of the Norwegian Framework regulations state that the Norwegian Ministry of Labor can require licensees to provide training of employees of the Ministry of Labor, the Ministry of the Environment, the Ministry of health and Care Services, the Norwegian Directorate of Health, the Petroleum Safety Authority of Norway, the Climate and Pollution Agency, the Norwegian Board of Health or other Norwegian authority. Additionally, the Ministry of Labor can require licensees to ensure that instructors who teach petroleum-related subjects at the Norwegian educational institutions, obtain practical on-the-job training at the licensee's offices, plants, and facilities.[99].

New Zealand - Under law, the few highly trained inspectors in the High Hazards Unit in WorkSafe are responsible for enforcing the controls on hazardous substances at well sites. The expertise of the High Hazards Unit should be reserved for the complexities of well design and construction. These inspectors are highly trained technical experts in the management and regulation of the oil and gas industry.

8.3 Equipment and Operations Inspected

As stated previously, the equipment or nature of operations inspected is typically driven by the prevailing regulatory regime in any one particular priority country. Equipment or operations can be precisely specified according to the prescriptive regulations or it may follow how the agreed upon safety case was written. Often times, inspection requirements are loosely worded in performance based regimes to allow for regulatory bodies to request all or any equipment and operations to be inspected to ensure safety. In some countries, such as Norway and UK, regulating bodies release historical audits and inspections for equipment/operations to increase transparency and improve overall sector learning opportunities. In UK the results are anonymized.

8.4 Inspection Frequency

Performance based regimes apply a risk-based methodology that may consider factors such as previous performance and compliance history, recent investigations, incident history, and other environmental and safety performance factors, industry incident trends, and responses to recommendations from previous inspections to determine their current inspection plan. Some regimes, such as in Brazil, remain silent on the set frequencies for inspection, with others such as Cuba set minimum requirements (e.g. at least once every five years), while countries like Denmark and New Zealand prefer to use discretion to set frequencies. Iceland is unique in that it

specifically sets inspection frequencies for each facility, as stipulated by the exploration/production license (though no such facilities yet exist). From a regulatory perspective, a primary benefit for a risk-based inspection frequency is the increased scheduling flexibility for allows for regulatory to prioritize inspections for installations which have the highest perceived risk. A main benefit of fixed-interval inspections in the eyes of a regulator is that conditions on an installation are monitored consistently, which may encourage compliance on the part of operator to maintain installation integrity to the satisfaction of prescriptive or performance-based requirements.

8.5 Non-Compliance Notification

In general, after the inspection of offshore equipment/facilities, priority country regulators issue forms of compliance/non-compliance determinations to offshore operators. Letters of non-compliance can be more performance-based, stating particular area(s) of deficiency/improvement, or can be prescriptive and require specific changes in equipment/activities. All active priority country offshore regulatory bodies issue some type of non-compliance notification to offshore operators in order to address health, safety, or environmental violations related to offshore equipment/activities. The method, timing, and required actions following an issued non-compliance notification vary. For example, based on the severity of the non-compliance, operators may have to address the deficiency immediately or face plant shut-down, or may have multiple months to address the situation. In Canada, the method of issuing non-compliance notifications is not explicitly stated in regulations, but the operator has key accountability to take necessary enforcement actions so that non-compliances with regulatory requirements are corrected in a timely fashion. Instances of non-compliance can be identified through internal or independent party audits and reports are submitted to the National Energy Board.

Other countries such as the Netherlands may also give warnings prior to issuing official letters of non-compliance, while Russia issues complete reports describing instances of non-compliance, if any, in the inspection carried out. Finally, countries such as Trinidad and Tobago, Venezuela, and Jamaica do not have explicit regulatory requirements on issuing non-compliance notifications.

8.6 Enforcement Tools

Across the priority countries analyzed, enforcement tools and actions vary from warnings all the way up to the suspension of operations and criminal prosecution. In the most extreme cases a license may be revoked, but actual examples of this have not been identified. Warnings typically are issued as a means of making the operator aware of an instance of non-compliance, while orders (e.g. to comply, to cease a specific activity) are more official and typically cite specific regulatory text. Orders also include specific timelines for achieving compliance and sometimes consequences for delayed non-compliance. Some countries such as Denmark issue a ‘consultancy note’, which requires that an operator obtain assistance from an authorized health

and safety consultant to solve one or more of its health and safety problems. Consultancy in Denmark notices can be issued for three different scenarios:

- Complex and serious health and safety problems;
- Investigation of psychological working environment; and
- Repeated violations.

This particular form of enforcement is used for serious and persistent offenders.

Norway has had success by first responding to non-compliance with a dialogue that deals with how non-conformity will be dealt with as well as a deadline for such action. Only after this dialogue has been unsuccessful does the PSA issue an 'order', which provides goals for a company to comply with and specific requests for changes and technology implementation.

8.7 Priority Country Inspection Program Overviews - Drilling and Production Operations

Australia

Inspection personnel training

There are no statutory/regulatory requirements for regulatory inspection personnel training in Australia during drilling and production operations. National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) is the country's offshore health, safety, and environment regulator.

Equipment and operations inspected

Overall, NOPSEMA inspections monitor compliance with an installation's safety case, and in general covers all equipment/operations emphasized/described in the document, with no specific checklist of inspection priorities. NOPSEMA inspectors operate on a quality assurance basis and inspections evaluate the controls and management systems of the responsible parties to reduce risks to a level that is a low as reasonably practicable. NOPSEMA states that each planned inspection focuses on, "verification of operator commitments regarding the recommendations from previous inspections and incident investigations and controls and/or management system elements selected in relation to at least one of the following: a major accident event (MAE) and an occupational health and safety hazard[100]."

Frequency of inspections

NOPSEMA inspections are scoped and scheduled according to a risk-based methodology that considers factors including previous performance and compliance history, industry incident trends, and responses to recommendations from previous inspections.

Notifications of non-compliance

Infringement notices are issued and enforced, per Division 5 of the Offshore Petroleum and Greenhouse Gas Storage Act (Volume 2). In the event that inspections identify

deficiencies in the controls and systems implemented, a lack of systems available, or significant omissions or errors in accepted regulatory submissions, that constitute either regulatory non-compliance or opportunities for improvement; it is NOPSEMA policy to secure compliance or improvement of the systems of the responsible party via recommendations, or enforcement action in accordance with the N-05000 core process series, as appropriate.

Enforcement tools

Enforcement actions include criminal penalties, fines, injunctions, adverse publicity orders, and suspension of offshore activities, and cancellation of title.

Other characterization

An aspect of the inspection processes in the Australian regulatory framework is high level of involvement of offshore operators in inspections/operations monitoring. Health and Safety Representatives (HSRs) are selected from offshore installations to help monitor health and safety conditions at the site. Powers granted to HSRs are outlined in Clauses 34-38 and 44 of Australia's Offshore Petroleum and Greenhouse Gas Storage Act (2006). Example powers of HSRs include initiating 'stop work' procedures, where there is an any immediate health and safety threat, performing health and safety inspections, and requesting inspections by offshore health and safety regulators. NOPSEMA publishes a handbook which provides legislative guidance to HSRs[xiii]. There are no obligations imposed on HSRs to exercise any powers granted to them, and HSRs "are not liable under civil proceedings for exercising or not exercising any of the powers outlined in the legislation."

Bahamas

Inspection personnel training

There are no statutory/regulatory requirements for regulatory inspection personnel training in the Bahamas during drilling and production operations.

Equipment and operations inspected

General broad inspection clause included in regulatory framework. Article 40 of the Bahamian Petroleum Regulations, Part II: Form of License, states items/purpose for regulatory inspection, including "to examine boreholes, wells, plans, appliances, buildings and works made or executed by the Licensee in pursuance of this license and the state of repair and conditions thereof…"

Frequency of inspections

[xiii] The HSR Handbook: A guide for health and safety representatives in Australia's offshore petroleum industry available here: http://www.nopsema.gov.au/assets/Publications/HSR-Handbook-2014.pdf

General clause indicating freedom of regulators to inspect a platform at any time. The Bahamian Petroleum Regulations state that "any person or persons authorized by the Governor-General or the Minister shall be entitled at all reasonable times to enter into and upon any of the licensed area for the time possessed or occupied by the Licensee."

Notifications of non-compliance

The Bahamian regulatory framework includes a process of notification prior to cancellation of petroleum licenses, not apparently designed for specific equipment/operations incompliance. Article 11(2) of the Petroleum Act of 1971 states, "prior to cancellation of a license or a lease under subsection (1), the Governor-General shall in writing inform the licensee or lessee of the grounds on which he considers that the license or lease ought to be cancelled and require that the licensee or lessee how cause within the time specified why the license or lease should not be canceled."

Enforcement tools

Fines, license revocation, and imprisonment are included as enforcement tools in the Bahamian regulatory framework. Penalties for performance of exploration operations without approval include both a monetary fine (up to $10,000) and imprisonment (not exceeding one year). Licenses can also revoked for several reasons, including for misrepresentation of information in a license application and any breach of license terms and conditions. The Bahamian government is also authorized to seek all costs for environmental pollution, including fines (not exceeding $120,000 and $5,000/day which offense continues) as well as imprisonment (up to two years).

Brazil

Inspection personnel training

There are no statutory/regulatory requirements for regulatory agency inspection personnel training in Brazil during drilling and production operations. The four offshore regulatory bodies are the National Petroleum Agency, the Navy, the Ministry of Labour, and the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA).

Equipment and operations inspected

Different operations/equipment are inspected by the four Brazilian regulatory bodies. For the National Petroleum Agency, inspections audit Management Practices (MPs) and Safety Management Systems at offshore facilities. The Brazilian Navy has auditing responsibilities including inspection/approval of structural elements of platforms and vessel navigational systems. Inspections by the Brazilian Ministry of Labour can be performed before commencement of offshore operations or periodically throughout the lifetime of an installation. Biannual environmental audits of offshore platforms are performed by IBAMA. These audits are designed to ensure offshore installations have up

to date documentation, including environmental licenses, risk management plans, and personnel training/accident records.

Frequency of inspections

No set inspection frequency addressed in Brazilian statutory/regulatory requirements. The National Petroleum Agency Annual Report of Operational Safety of Oil and Gas Exploration and Production Activities indicates that platform inspections are generally performed once a year for most facilities.

Notifications of non-compliance

Three types of non-conformity reports are issued according to severity of operators' violations of their safety management systems. These include critical (facility must stop operations to prevent an accident), major (operator has 30 days to fix the non-conformity), and minor (operator has 120 days to fix the non-conformity).

Enforcement tools

Penalties/enforcement tools administered in Brazil include suspension of operations (partial or complete), revocation of licenses, and monetary penalties. Operators who do not fix violations cited in non-conformity reports within required time periods may also be fined or ordered to cease operations.

Other characterization

Offshore inspections in Brazil are focused on auditing operators' Safety Management Systems (SMS), which are segmented into 17 management practices (MPs) and organized in three larger groups: leadership, personnel, and management; physical infrastructure and technology; and operational practices. The National Petroleum Agency publishes an annual report with data gathered from inspections and incidents.

Canada

It is important to note that different provinces in Canada may have separate regulations and requirements that expand upon the Canada Oil and Gas Operations Act (COGOA) and requirements of the National Energy Board. Examples include Canada-Newfoundland & Labrador Offshore Petroleum Board and Canada-Nova Scotia Offshore Petroleum Board. These requirements are not analyzed in detail, but Canada's overarching 'hybrid approach' of combing prescriptive and performance based standards remains consistent across each of these separate regulating entities.

Inspection personnel training

Canada, like many priority countries, has explicit requirements stating how the operator shall ensure their personnel are trained for routine inspections. These requirements include the fact that all personnel have, before assuming their duties, the necessary experience, training and qualifications and are able to conduct their duties safely,

competently and in compliance with prevailing Canadian offshore regulations. Additionally, records of the experience, training and qualifications of all personnel are kept and made available to the National Energy Board upon request.

Equipment and operations inspected

Under the COGOA, regulatory bodies at any time have the ability to:

- Enter and inspect any permit area or lease area;
- Enter and inspect any place or building used in connection with the refining, handling, processing or treating of oil or gas;
- Inspect any well, record, plant or equipment located in or on any place or building referred to in paragraph (a) or (b).

The details of what can and cannot be inspected are not specified. Rather, the regulations are more performance based and allow for the inspection of virtually anything.

Frequency of inspections

Similar to the flexibility of what equipment and operations inspected, the Canada Oil and Gas Operations Act (COGOA) grants flexibility to the regulatory body on how often and when inspections are carried out. No specific regulations or requirements exist on what minimum standards must be met by the regulatory body. However, similar to many other priority countries, minimum inspection schedules for equipment and operations must be met on the operator's side.

Notifications of non-compliance

When an operator violates any provision of the COGOA or other applicable regulations, the regulator may give written notice to the operator. Warnings and official orders may also be issued depending on the severity of the instance of non-compliance.

Enforcement tools

When an operator violates any provision of the COGOA or other applicable regulations, unless the operator remedies or prepares to remedy the violation to the satisfaction of the regulator within 90 days from the date of the notice, the regulating body has the authority to cease operations. In addition to these general requirements, stoppage of operations and prosecution of responsible parties are other enforcement tools available across regulating entities in Canada.

Cuba

Inspection personnel training

There are no statutory/regulatory requirements for regulatory agency inspection personnel training in Cuba drilling and production operations.

Equipment and operations inspected

No specific equipment/operations are identified in Cuban statutory/regulatory requirements. Inspections are focused environmental compliance in the Cuban offshore regulatory framework and inspectors are given administrative power to access offshore facilities as well as review supporting documents for compliance verification.

Frequency of inspections

No specific equipment/operations are identified in Cuban statutory/regulatory requirements.

Notifications of non-compliance

Non-compliance notifications are issued for violations of environmental legislation on offshore facilities by the Ministry of Science, Technology, and Environment.

Enforcement tools

Enforcement tools include halting/closure of operations and suspension of licenses, permits, and other authorizations for violations of environmental legislation on offshore.

Denmark

Inspection personnel training

There are no statutory/regulatory requirements for regulatory agency inspection personnel training during offshore drilling and production operations in Denmark. Responsibility for enforcing the Offshore Safety Act was transferred on January 1, 2015 from the Danish Energy Agency (DEA) to the Working Environment Authority (WEA). There were very few technical specialists within the DEA, and a majority of employees were lawyers.

Equipment and operations inspected

There are no specifications on equipment and operations to be inspected by offshore regulators in Danish legislation. Inspection of equipment and operations are at the discretion of the WEA, based on plans submitted by operators to the agency for approval of activities/operations. The WEA states that "the cornerstone of supervision is the companies' self-monitoring in the form of a management system for health and safety, to ensure and document that the regulatory requirements are met and that the execution and design of offshore installations and jobs are done with minimal risk to people and property[101]." The WEA notes, "Inspections cover both single and more general issues and is focused on the individual circumstances[102]."

Frequency of inspections

No set inspection frequency established in Danish law. Inspection frequency is at the WEA's discretion, with priority consideration given to special operating conditions at offshore facilities.

Notifications of non-compliance

Non-compliance infractions are brought to the attention of operators by the WEA.

Enforcement tools

Several enforcement tools available to offshore regulators. One form of enforcement used for serious and persistent offenders is known as a Consultancy notice, which requires an operator to obtain assistance from an authorized health and safety consultant to solve one or more of its health and safety problems. Consultancy notices are issued for three different scenarios:

1) Many or complex and serious health and safety problems;
2) Investigation of psychological working environment; and
3) Repeated violations.

Other enforcement tools available in Denmark include improvement notices, legal charges/imprisonment, and administrative fines and guidelines. Assessments/audits of offshore operators are made public and available for review from the WEA website. The WEA can also halt operations and order cancellation of shipment of hazardous equipment, materials/substances, or personal protective equipment to the installation.

Iceland

Inspection personnel training

There are no statutory/regulatory requirements for regulatory agency inspection personnel training offshore drilling and production operations in Iceland.

Equipment and operations inspected

There are no specifications on equipment and operations inspected by offshore regulators in Iceland's regulatory framework, though there are legal provisions for supervisory action by the National Energy Authority. Act Number 13, "On Prospecting, Exploration and Production of Hydrocarbons," Article 24a, states the "National Energy Authority may demand all the information and data that are necessary for supervision according to this Act from the holder of a prospecting, exploration, and production license. Such data and information shall be delivered within reasonable time limits as decided by the National Energy Authority. The National Energy Authority may also impose regular reporting from these parties on matters that are important for the supervision[103]."

Frequency of inspections

Inspection characteristics are established for each individual offshore facility, as stipulated in the exploration/production license. No set frequency of inspections is established in statutory/regulatory requirements. Regulation Number 884: "On Prospecting, Exploration, and Production of Hydrocarbons," addresses access to offshore facilities by regulators. Section X, Article 58 states, "The licensee is under obligation, at

all times, to provide the representatives of the National Energy Authority and the consultation group supervising prospecting, exploration and production of hydrocarbon in Iceland, as provided for in Article 24 of the Hydrocarbons Act, access to vessels, offshore facilities and other installations connected with the hydrocarbon production of the licensee. The same applies to data, samples and other information as deemed necessary by the National Energy Authority or the consultation group to enable these entities to carry out their monitoring role and to meet administrative goals of developing knowledge in the field of hydrocarbon production. Moreover, the representatives shall be entitled to monitor exploration activities and production carried out on the basis of the license. The licensee shall permit the above representatives to remain onboard vessels and offshore facilities as long as necessary…[104]"

Notifications of non-compliance

Iceland has established regulatory non-compliance procedures. Act Number 13, Article 24b states, "if the holder of a prospecting license or an exploration and production license does not comply with the requirements of this Act, with regulations based on this Act, with the exploration and production license or other sources, the National Energy Authority shall give written notice of warning to the licensee with ample time limit for remedies but daily penalties pending[105]."

Enforcement tools

The offshore regulator, the National Energy Authority, has the power to enforce daily monetary penalties/collection of costs associated with fine payments as well as revoke upstream offshore operations licenses.

Jamaica

Inspection personnel training

There are no statutory/regulatory requirements for regulatory agency inspection personnel training offshore drilling and production operations in Jamaica.

Equipment and operations inspected

There are no specifications on equipment and operations inspected by offshore regulators in Jamaica's regulatory framework.

Frequency of inspections

No set frequency of inspections is established in Jamaican statutory/regulatory requirements.

Notifications of non-compliance

No requirements for regulatory non-compliance notifications to offshore operators established in Jamaican petroleum legislation.

Enforcement tools

Violations of the Jamaican Petroleum Act of 1979 can result in both fines and/or imprisonment.

Mexico

Inspection personnel training

There are no statutory/regulatory requirements for regulatory agency inspection personnel training during offshore drilling and production operations in Mexico.

Equipment and operations inspected

There are no specifications on equipment and operations inspected by offshore regulators in Mexico's regulatory framework, although the National Hydrocarbons Commission has released monitoring standards for deepwater equipment/operations, including blowout preventers (BOPs), cementing operations and Remotely Operated Vehicles (ROVs),.

Frequency of inspections

No set frequency of inspections is established in Jamaican statutory/regulatory requirements.

Notifications of non-compliance

The National Hydrocarbons Commission authorizes issuance of non-compliance notifications to offshore operators, which provide the basis for sanctions.

Enforcement tools

Enforcement tools available to the National Hydrocarbons Commission identified in statutes and regulations include monetary penalties for incompliance, revocation of permits, suspension/temporary shutdown of equipment/operations, and ordering decommissioning of offshore facilities and systems.

Netherlands

Inspection personnel training

There are no statutory/regulatory requirements for regulatory agency inspection personnel training offshore drilling and production operations in the Netherlands.

Equipment and operations inspected

There are no specifications on equipment and operations inspected by offshore regulators in the Netherlands regulatory framework, although the State Supervision of Mines reveals inspection priorities in its Annual Report in the realm of offshore safety, health, and environmental (SHE) matters. In the realm of safety the inspection priorities include the release of flammable or explosive medium, the loss of integrity of an installation/well/or pipeline, unavailability of survival equipment and incorrect actions during emergency situations, and unsafe activities or situations during diving work, working at heights, and with lifting activities and with systems with potential energy (pressure, electricity,

gravity, and temperature). In the realm of health the inspection priorities include exposure to hazardous substances and biological agents (gases, fumes, sprays, dust), food/water contamination (poisoning, legionella), prolonged exposure to physical factors (noise, vibrations, ventilation, radiation, overpressure), and exposure to physical strain (lifting) or psychological factors (workload, speed, working hours, content and organization of work). Lastly in the realm of environment, the inspection priorities include an uncontrolled release of large amounts of environmentally hazardous substances (environmental disasters), emissions during operational activities, whereby a core provision is exceeded, emissions during operational activities, whereby an agreement (covenant) is exceeded, and emissions as a result of occasional unforeseen incidents, if minor in extent and not deliberately caused.[106].

Frequency of inspections

No set frequency of inspections is established in the Netherlands statutory/regulatory requirements. The most recent publicly available Annual Report (2007) from the State Supervision of Mines provides information on the number of total yearly inspection performed from 1992-2007. The number has appears to have significantly declined over that period. In 1992: 1,816 inspections were performed, and in 2007: 444 inspections were performed[107].

Notifications of non-compliance

The Ministry of Economic Affairs (of which the State Supervision of Mines is a subordinate body) issues warnings to operators who are in violation of terms of a license (Article 21 of Mining Act)[108].

Enforcement tools

The Ministry of Economic Affairs (of which the State Supervision of Mines is a subordinate body) has the authority to withdraw an operator's license (Article 21 of Mining Act) and fine operators. Additionally, regarding decommissioning/removal procedures, the Ministry has the authority to set time limits for removal activities to be completed (Article 44 of Mining Act)[109].

New Zealand

Inspection personnel training

Information available from WorkSafe, New Zealand's offshore regulator, indicates that there are only a few "highly trained" inspectors in the High Hazards Unit which is responsible for enforcing controls at well sites. In 2014, the High Hazards Unit had 4 highly trained inspection personnel and more are continuously being recruited and trained. These inspectors are highly trained technical experts in the management and regulation of the oil and gas industry. There are no statutory/regulatory requirements for regulatory agency inspection personnel training during offshore drilling and production operations in New Zealand.

Equipment and operations inspected

All structures and equipment required for safe operation as identified in an installation's safety case are included in certificate of fitness inspections. New Zealand regulations state a certified inspection body must "carry out such inspections or examinations of installations, and equipment fixed to or associated with installations, as may be necessary to determine the safety of such installations and equipment; and issue certificates of fitness in respect of the safety of the structure of an installation, equipment fixed to the structure; and other equipment necessary for the safe operation of an installation[110]."

Frequency of inspections

Safety inspections by WorkSafe are prioritized by the inherent hazard of the installation, operator performance which includes an assessment of the effectiveness of the management of risk of the installation(s), and other operational intelligence (e.g. a new operator is subject more likely to inspection). A date of expiry for the certificate of fitness is given and may be at intervals of less than five years.

Notifications of non-compliance

Non-compliances notices are issued to operators if an inspection body does not endorse a facility's safety case.

Enforcement tools

WorkSafe, local councils, and inspection bodies have the authority to halt operations if a safety case or certificate of fitness is out of compliance.

Other characterization

A current certificate of fitness demonstrates that the installation's structure and all equipment necessary for the safe operation of the installation are appropriately designed, in good working order and in a good state of repair. Retaining currency of the certificate of fitness is required for the installation's operational lifecycle.

Norway

Inspection personnel training

The country's offshore regulator, the Petroleum Safety Authority (PSA) describes that regulatory personnel are organized into six different teams, each dealing with a portfolio of petroleum industry players. Each team is headed by a supervision coordinator and personnel who serve as contacts for a specific set of industry players. Section 65 of the Norwegian Framework regulations states that the Norwegian Ministry of Labour "can order licensees to provide training of employees of the Ministry of Labour, the Ministry of the Environment, the Ministry of health and Care Services, the Norwegian Directorate of Health, the Petroleum Safety Authority of Norway, the Climate and Pollution Agency, the Norwegian Board of Health or other Norwegian authority. Such training shall take

place according to further agreement." Additionally, "the Ministry of Labour can order licensees to ensure that teachers who teach petroleum-related subjects at the Norwegian educational institutions, obtain practical on-the-job training at the licensee's offices, plants, and facilities."

Equipment and operations inspected

There are no specifications on equipment and operations inspected by offshore regulators in the Norwegian regulatory framework, although the PSA releases statement on inspection priorities on its website. In 2015, these priorities are field-level planning and management to meet challenges with older facilities, maintenance management of mature facilities, drilling and well activities at older facilities, and planning, prioritization and execution of modifications for older facilities. All installation/operator audit reports performed by the PSA are publicly available on the PSA website, organized by 10 topics, namely, Acknowledgement of compliance (AoC), Cranes and lifting, Emergency preparedness, SHE management, Maintenance management, Natural environment, Process integrity, Structural integrity, Well integrity, and Working Environment.

Frequency of inspections

No set frequency of inspections are identified in Norwegian offshore petroleum operations. The PSA uses a risk-based analysis to prioritize inspections at the discretion of PSA employees. Factors which play a role in the evaluation of facilities include operator reputation, history of accidents, and negative anonymous reports from platform/operations personnel. According to the PSA website, the agency consists of approximately 170 staff members, and is responsible for inspecting over 75 permanent installations, 40 mobile units, and approximately 300 subsea installations.

Notifications of non-compliance

A notice known as a “notification of order” is issued to operators prior to issuance of a second notice named an “order.” An order is legally binding document issued by the PSA signifying the severity of an operator's regulatory breach in terms of health, safety, and emergency preparedness and that "a strong reaction to less serious regulatory breaches is necessary because the company has been unable or unwilling to correct the same or similar breached when our response has not had legal force."

Enforcement tools

Norway's Petroleum Safety Authority's (PSA's) most frequent response to non-compliance is dialogue which deals with how non-conformity will be dealt with as well as a deadline for such action. Beyond communication, the next strongest preventive instrument is known as an order. An order generally provides goals for a company to comply with and does not request for specific changes or technology implementation.

Other instruments available to the PSA include shutting down operations and filing charges with the police, as regulated by written guidelines. The most severe enforcement tool available to the Petroleum Safety Authority is to ban a party from operating in the Norwegian petroleum sector. To date no such ban has been utilized[111].

Russia

Inspection personnel training

Training of inspection personnel should be provided by an authorized/licensed company every 2, 3, and 5 years. Compliance with this requirement is checked annually.

Equipment and operations inspected

Any offshore equipment or operations can be inspected by Russian authorities, according to standards published by the agencies Gosgorteknadzor and GosStandart.

Frequency of inspections

Random and scheduled regulatory inspections are applicable to offshore operations in Russia. There are approximately 3-4 inspections of offshore installations annually.

Notifications of non-compliance

For non-compliances, inspecting agencies issue reports to operators to address violations within a specified timeframe. Incidents of non-compliance are required to be reported to regulatory authorities by operators.

Enforcement tools

Enforcement tools available to regulators violations of license requirements and environmental standards include fines, suspension of subsurface licenses, and criminal prosecution for serious infractions.

Trinidad and Tobago

Inspection personnel training

There are no statutory/regulatory requirements for regulatory agency inspection personnel training for oversight of offshore drilling and production operations in Trinidad and Tobago. Offshore inspector training has been held on topics including asset integrity and risk-based inspections, from information published on the Ministry of Energy and Energy Affairs website.

Equipment and operations inspected

The Health, Safety, and Environment (HSE)/Measurement Division of the Ministry of Energy and Energy Affairs is authorized to inspect all equipment and operations.

Frequency of inspections

The Petroleum Regulations in Trinidad and Tobago do not specify inspection frequency for offshore facilities.

Notifications of non-compliance

The Petroleum Regulations in Trinidad and Tobago do not specify forms of non-notification compliance.

Enforcement tools

The Petroleum Regulations in Trinidad and Tobago include fines for regulatory non-compliances.

United Kingdom

Inspection personnel training

The Health and Safety Executive (HSE) primarily recruits young technical graduates who complete a two year MSc in Regulatory Health and Safety as part of their early development, as well as mature professionals with industry experience. Offshore inspection priorities, standards, and expectations of Inspectors are publicly available, as is the Guidance for topic assessment of the major accident hazard aspects of safety cases (GASCET) manual which is used by HSE Offshore Safety Directorate (OSD) inspectors in offshore installation safety case assessments.

Equipment and operations inspected

Inspections by the Health and Safety Executive (HSE) Offshore Safety Division (OSD) are risk-based and are aimed at verifying whether what is stated in a Safety Case actually happens in practice. Inspection priority for offshore installations is based on the inherent hazard of the installation, operator performance, including an assessment of the effectiveness of the management of risk of the installation(s), and other operational intelligence (e.g. a new operator is subject more likely to inspection). During offshore inspections, HSE inspectors always meet privately with one or more Safety Representatives to review workforce involvement. The Health and Safety Executive (HSE) also uses sector-wide Key Programmes to evaluate industry performance of hydrocarbon releases, deck and drilling operations, and asset integrity. The Key Programmes started following a Parliamentary debate, when the Secretary of State for Work and Pensions commissioned the Health and Safety Executive to review the progress made by the UK offshore oil and gas industry. The Health and Safety Executive initiated the Aging and Life Extension Inspection Programme (KP4) in 2010 to promote awareness and management of risks associated with aging infrastructure in the offshore oil and gas industry. Inspection areas covered by the program include corrosion, fire and explosion, structural and marine integrity, process safety, pipelines, mechanical, electrical, control and instrumentation, and human factors[112].

Frequency of inspections

There is no established frequency of inspections for offshore installations. Safety inspections by the Health and Safety Executive are prioritized by the inherent hazard of the installation, operator performance, including an assessment of the effectiveness of the management of risk at the installation(s), and other operational intelligence (e.g. a new operator is subject more likely to inspection). Reactive inspections are performed for reported accidents that meet HSE incident selection criteria (notified through Reporting of Injuries, Diseases and Dangerous Occurrences Regulations - RIDDOR - reports) and concerns reported through a confidential website operated by the HSE.

Notifications of non-compliance

Post-inspection letters are issued to operators detailing any issues of concern on offshore installations.

Enforcement tools

In addition to post-inspection letters, more severe notification/enforcement tools include Improvement Notices (INs) and Prohibition Notices (PNs) and prosecutions. There is a very detailed Enforcement Guide for Inspectors (Scotland version also available, taking account of the small variations in the Scottish legal system). Enforcement Decisions may include serving notices to duty holders, withdrawing approvals, varying licenses, conditions or exemptions, issuing simple cautions, prosecution, and providing information or advice, face-to-face, or in writing. INs and PNs are worded carefully to define only the area(s) of concern, and can be appealed by the duty holder – but this is rare. It is also rare for HSE to lose a prosecution once it is initiated. High Court fines for H&S offences are unlimited. In cases of gross negligence resulting in one or more fatality, the Police working with HSE, can charge a duty holder organization with Corporate Manslaughter/Homicide – but this is rare and has not yet happened in the offshore sector. The searchable register of prosecutions and notices is public and courts also have powers to require a guilty party to further advertise details of a case upon conviction.

Environmental Inspectors (DECC) have similar powers and approaches to HSE, but less detail is publicly available of their inspection priorities and standards.

United States

Inspection personnel training

There are no statutory/regulatory requirements for regulatory agency inspection personnel training for oversight of offshore drilling and production operations in the United States. For offshore companies/operators, the training method and frequency is self-determined.

Equipment and operations inspected

The Bureau of Safety and Environmental Enforcement (BSEE) is the primary regulatory entity to enforce safety and environmental compliance in United States offshore petroleum operations. The annual inspection examines "all safety equipment designed to prevent blowouts, fires, spills, or other major accidents." There are two primary categorized lists of items which BSEE inspects/review for Potential Incidents of Noncompliance (PINCs): one for field inspection of equipment/operations and one for verification of all submitted plans/paperwork (known as Office Non-compliances).

Frequency of inspections

The Outer Continental Shelf Lands Act gives BSEE the authority to conduct an annual scheduled inspection as well as a periodic unscheduled inspection of offshore facilities.

Notifications of non-compliance

A listing of PINCs are described in a document named the "Office Potential Incident of Noncompliance List[xiv]." PINCs are detailed in the document by several descriptive pieces of information, including a PINC statement ("clear and concise description of the requirement"), associated inspection procedure ("preferred detailed guidelines to be used by BSEE personnel to ensure that the stated requirement is met"), enforcement actions if non-compliances exist, and count of non-compliances to be issued (e.g. either per inspected facility or safety device). Categories of PINCs include General Operations, Archaeological concerns, Records, Platforms and Structures, Bonding, Training (operations-related and environmental), Production Reporting, Accident Reporting, Sand and Gravel, Oil Spill Response Plans, Inspection Exercises, Oil Spill Reports, Drilling Plan Approval, Drilling Casing Program, Drilling Well Control, Drilling Rig Movement, Drilling Well Completions, Drilling Well Workover, Decommissioning, Production venting and flaring, Sustained Pressure Casing Management, Pipeline Installation/Re-location, Pipeline Testing, Pipeline Out-of-service reporting, Pipeline Repair, Pipeline Decommissioning, Company Information, Conservation of Resources Interests, Enhanced Recovery, Production Rate, Well Tests, Bottomhole Pressure Surveys, Production Measurement and Site Security, Geological and Geophysical Exploration Permits, and Data Collection.

Enforcement tools

Depending on the severity of non-compliance violations, inspectors can issue either Warning or a Shut-In Incidents of Noncompliance (INCs). Warning INCs must be corrected within a reasonable amount of time specified on the notice; shut in INCs may apply to either a single equipment component/piece of equipment/portion of a facility or

[xiv] National Office Potential Incident of Noncompliance (PINC) List available online for review here: http://www.bsee.gov/uploadedFiles/BSEE/Inspection_and_Enforcement/Enforcement_Programs/2015_PINC_Lists/Office%20PINCS%20-%20Final%205.15.pdf

the entire offshore facility, and the violations have to be corrected before the operator is allowed to continue the activity in question. Additional enforcement tools include civil penalties (up to $40,000/day) for failure to correct violations within times specified on the INC notices or which pose a severe threat to harm or damage human life or the environment.

Venezuela

Inspection personnel training

There are no statutory/regulatory requirements for regulatory agency inspection personnel training for oversight of offshore drilling and production operations in Venezuela.

Equipment and operations inspected

There is no checklist for oil and gas operations inspected in the Venezuelan statutory/regulatory framework.

Frequency of inspections

Inspection frequency is not addressed in the Venezuelan regulatory framework.

Notifications of non-compliance

Notification for offshore SHE violations are not addressed in the Venezuelan regulatory framework.

Enforcement tools

The Venezuelan Ministry of Energy and Petroleum has the authority to revoke licenses for offshore operations and additional penalties include monetary fines, as well as other undescribed civil, criminal, fiscal, and administrative sanctions.

9 Considerations Going Forward

ICF has compared the regulatory framework and requirements for the 17 priority countries across key offshore regulatory areas, ranging from permitting to shallow vs. deepwater considerations, to safety management system requirements. Using qualitative/quantitative charts and descriptive analysis, each priority country's regulatory system has been compared and contrasted to identify similarities and inconsistencies and provide an overall ranking of priority country approaches. Throughout this process, subject matter expertise was leveraged along with a focused research effort to provide both detailed input and wider perspectives on these key areas of comparison. The overall goal is to identify opportunity areas for U.S. regulatory improvements and offer considerations that could be used to implement these potential changes.

The future of offshore operations continues to present many uncertainties and unique challenges. The one constant is the fact that new operational areas and drilling environments will tend to evolve and be more complex and push technological boundaries. Considering this outlook, ICF offers these considerations going forward:

1. ***Continue to Pursue a Hybrid Based Regulatory System***
    a. Change the mindset to a safety case regime
    b. Build expertise and resources within BSEE
    c. Establish a "general duty of care" mantra for BSEE and the industry
2. ***Improve Monitoring and Reporting of Safety Indicators for Offshore Operations***
    a. Well kicks
    b. Number of cement failures
    c. Number of gas alarms
    d. Monitoring the effectiveness of barriers
    e. DP (Dynamic Positioning) station keeping effectiveness
    f. BOP reliability
    g. Near misses and general incident monitoring
3. ***Continue to Develop Arctic Specific Performance-Based Standards for Offshore Operations***
    a. Foster increased innovation on the part of industry to meet SHE goals while operating in Arctic subsea and metocean conditions.

10 APPENDIX

10.1 Special Considerations for Littoral Arctic Countries

As production from traditional and easy to access formations declines over time, new areas around the world are being explored for oil. The characteristics of these new areas tend to be unique and often challenging from an operational point of view. For littoral Arctic countries, operating in the Arctic Ocean presents some of the harshest environments for offshore activities. Remoteness, prolonged periods of ice coverage and darkness, fog, floating ice, lack of infrastructure, and extreme freezing temperatures are just some examples of the operational and logistical challenges encountered in the Arctic Ocean. Compounding the issue, offshore activity in the United States is dominated by the Gulf of Mexico. As a result of this focused oil and gas activity in temperate waters, current U.S. technology, standards and practices for offshore operations is more suited for those conditions. Finally, the presence of ice in the Arctic further exacerbates all recovery/remediation efforts in the event of an adverse event such as a blowout or an oil spill.

Post Macondo, littoral Arctic countries have made strides in identifying and developing regulatory standards that will be applicable to operations in the Arctic Ocean. In an October 2012 letter from the Ocean Energy Safety Advisory Committee (OESC), recommendations were made to the DOI and BSEE regarding the need to "develop Arctic specific regulations and/or incorporate standards for prevention, safety, containment and response preparedness in the Arctic OCS"[113]. Ensuring that technical understanding and capability were satisfactory for oil spill response and developing fit-for-purpose technologies and regulations in the Arctic were among some of the specific recommendations made. The OESC did not believe BSEE regulations adequately addressed the unique Arctic operating conditions. This section will further discuss how to characterize and group Arctic challenges, key standards to consider, and other areas of note as they relate to offshore activities in the Arctic region.

Characterizing Arctic Operating Challenges

Table 14 below provides a visual overview of the various challenges faced while operating in the Arctic Ocean. Favorable conditions are highlighted in green, while a color gradient is used to represent a transition to unfavorable conditions. For example, the presence of sea ice, whether broken or solid, can present challenges for operators and indicates a more unfavorable operating condition and is more prevalent during winter months. Factors like fog and darkness can also have an impact on arctic exploration and production and are prevalent from the fall months into early to late spring. Essentially, when these challenges are taken into account, operators have a very small window of opportunity (approximately June to August) to operate in the Arctic under ideal conditions.

Table 14– Arctic Operational Challenge Burn Chart

Time of Year / Op. Challenge	Winter			Spring			Summer			Fall		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sea Ice												
Wave Height												
Wind Speed												
Darkness Condition												
Fog Intensity												
Extreme Low Temperature												

Arctic Specific Regulations

Countries operating in the Arctic may have regulations that are predominantly performance-based or prescriptive in nature, however, regardless of the regulatory approach of any one country, the current requirements rarely differentiate between operating environments (e.g. Gulf of Mexico vs. the Arctic). Standards tend to be broad, not taking into account the unique characteristics for a particular region as identified in
Table **14** above. Performance based regulatory regimes tend to be ahead of the curve when tackling this problem, as their standards are goal oriented and allow the operator to innovate while addressing both general and location-specific hazards and risks in the Arctic region. Thus, while Arctic specific regulations are not explicitly outlined in performance based regimes, the fact that by their very nature, the burden is on the operators to identify hazards and mitigate risks specific to the operations in question. Hence specific requirements for enhancing Arctic operations naturally fall out of this process. In contrast, prescriptive based regimes tend to lag when addressing new and unique operating environments for exploration and drilling. It is very difficult for operators to gain approval to explore or drill in a challenging region such as the Arctic until standards or requirements are in place to adequately address the concern for safety and environmental related requirements. Standard setting is time consuming and may limit the innovative ability of a company when the final standards are finally put into place. Essentially, performance-based standards are more flexible as offshore activities move into new, unique conditions.

Table 15 below provides an overview of the major Arctic countries and evaluates their current levels of exploration/production activity in addition to whether or not rules specific to Arctic exploration exist.

Table 15– Arctic Exploration Activity and Specific Requirements

Country / Requirement	United States	Norway	Canada	Denmark	Iceland	Russia
Level of Arctic Exploration Activity						
Permitting Activities	○*	✓	✓	○	○	○
Real Time Monitoring of Offshore Operations	○*	✓	✓	○	○	○
Equipment Failure Reporting Systems	○	✓	✓	○	○	○
Accident Near Miss Reporting	○	✓	✓	○	○	○
Shallow vs. Deepwater						
BOP	○*	✓	✓	○	○	○
Cementing	○	✓	✓	○	○	○
ROV	○	✓	✓	○	○	○
Drilling and Production Activities Inspection Program	○	✓	✓	○	○	○
Phases of Offshore Activity Regulated by use of a Safety Management Systems (SEMS, SEMP, etc.)	○*	✓	✓	○	○	○

Legend

✓	Specific requirements for the Arctic
○	Specific requirements not addressed
○*	Specific requirements not addressed, but proposed

Green shading indicates a higher level of activity, whereas a red shading indicates little to no Arctic activity. Yellow shading refers to a medium level of activity. It is important to note that while countries like Norway and Canada do not have explicitly written standards that apply to Arctic exploration, their regulatory standards are sufficiently structured to allow operators to innovate and meet the overarching goals of the regulator by taking the necessary precautions to mitigate risks in unique operating environments. Thus, these countries do indeed have "Arctic specific" requirements, albeit implicitly, whereas the U.S. has proposed prescriptive standards for certain discrete areas that have yet to be approved. Russia, although having extensive offshore activities in the Arctic region, their regulatory system provides little clarity or differentiation on what standards, if any, are unique to activities in the Arctic. According to sources in the industry and government officials who collaborate with Russia in the Arctic, Russia's regulatory and environmental framework is notoriously lax[114]. Due to lack of activity,

both Denmark (Greenland) and Iceland are relatively silent on Arctic-specific regulations or standards.

Finally, challenges will increase if we were to attempt to analyze production activities across priority countries in the Arctic region. Many companies, such as Shell, have engaged in innovative solutions to manage the complex production environment that exists when dealing with ice, fog, darkness, extreme temperatures, and limited infrastructure. Technologies will continue to improve at a rapid pace, and regulatory bodies will need to maintain their expertise and awareness of what innovations are on the cutting edge of the industry.

10.2 Regulations/Statues Review by Country

Details on offshore regulatory entities and regulations/statues reviewed for this report are listed below in Table 16.

Table 16 – Priority Country Regulatory Entity and Regulations Overview

Country	Offshore Regulatory Entity	Regulations/Statutes
Australia	National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA)	▪ Offshore Petroleum and Greenhouse Gas Storage Regulations ▪ Offshore Petroleum and Greenhouse Gas Storage Act
Bahamas	Ministry of Environment and Housing	▪ Bahamian Petroleum Act ▪ Bahamian Petroleum Regulations
Brazil	▪ National Petroleum Agency (ANP--Agência Nacional de Petróleo) ▪ Institute of Environment and Natural Resources (IBAMA--Instituto Brasileiro de Meio Ambiente e dos Recursos Naturais Renováveis) ▪ Brazilian Navy – Directory of Ports and Coasts (Diretoria de Portos e Costas)	▪ Technical Regulation of the Operational Safety Management System of Maritime Installations of Oil and Natural Gas Drilling and Production [Regulamento Técnico do Sistema de Gerenciamento Da Segurança Operacional das Instalações Marítimas de Perfuração e Produção de Petróleo e Gás Natural (ANP Nº 43)] ▪ CONAMA Regulation Number 23/1994 ▪ CONAMA Regulation Number 237/1997 ▪ ANP Regulation Number 27/2006 ▪ IBAMA Regulation Number 306/2002 ▪ IBAMA Regulation Number 381/2006 ▪ ANP Regulation Number 44/2009
Canada	▪ Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) ▪ Canada-Nova Scotia Offshore Petroleum Board (C-NSOPB) ▪ Canada National Energy Board (NEB)	▪ Nova Scotia Offshore Marine Installations and Structures Transitional Regulations ▪ Nova Scotia Offshore Certificate of Fitness Regulations ▪ Nova Scotia Offshore Petroleum Drilling and Production Regulations ▪ Nova Scotia Offshore Petroleum Installations Regulations ▪ Newfoundland and Labrador Offshore

		Certificate of Fitness Regulations ▪ Newfoundland Offshore Petroleum Drilling and Production Regulations ▪ Newfoundland and Labrador Marine Installations and Structures Occupational Health and Safety Transitional Regulations ▪ Newfoundland Offshore Area Oil and Gas Operations Regulations ▪ Newfoundland Offshore Petroleum Installations Regulations ▪ Canada Oil and Gas Drilling and Production Regulations ▪ Canada-Newfoundland and Labrador Atlantic Accord Implementation Newfoundland Act
Cuba	▪ Ministry of Energy and Mining ▪ Oil and Gas Planning Directorate ▪ Oil and Gas Evaluation and Control Directorate	▪ Regulation Number 299: Procedure to Qualify International Companies Interested in Oil and Gas Exploration and Production in the Republic of Cuba ▪ Regulation Number 118-03: Procedure to Permit Drilling Operations for Exploration and Production of Hydrocarbons ▪ Regulation Number 117-03: Regulation of Final Closure of Abandoned Wells, Temporal Closure of Wells, and Facility Decommissioning ▪ Regulation Number 115: Regulation for Environmental Protection of Petroleum Exploration and Production Activities ▪ Regulation Number 103: Regulation of State Inspection for Environmental Regulatory Activity

		▪ Regulatory Guide: Preparation of Safety Reports for Drilling of Offshore Oil and Gas Wells
Denmark (including Greenland)	Working Environment Authority (formerly Danish Energy Agency) Bureau of Minerals and Petroleum (Greenland)	▪ Regulation Number 520, May 13, 2013. Consolidated Act on Safety, etc. for Offshore Installations for Exploration, Extraction and Transport of Hydrocarbons (Offshore Safety Act) ▪ Danish Energy Agency's Guidelines on Safety and Health Related Conditions on Offshore Installations, etc.: Approvals and Permissions, December 2012 ▪ Guide to Hydrocarbon Licenses in Denmark: Exploration and Drilling Activities, September 2011
Iceland	National Energy Authority	▪ Act Number 13.On Prospecting, Exploration and Production of Hydrocarbons (unofficial translation). March 13, 2001 and last amended by Act Number 59, April 10, 2013 ▪ Regulation Number 884/2011. On Prospecting, Exploration and Production of Hydrocarbons
Jamaica	Prime Minister – no distinct offshore regulatory body	Jamaica Petroleum Act 1979
Mexico	▪ National Hydrocarbons Commission ▪ Agency of Industrial Safety and Environmental Protection ▪ Secretary of Energy	▪ 2014 Law of Petróleos Mexicanos (PEMEX) ▪ National Hydrocarbon Commission (CNH – Comisión Nacional de Hidrocarburos) Regulations 06.002/09 and 02/001/13. Technical Guidelines on the Design and Review of Hydrocarbon Exploration Projects. ▪ CNH Regulation 03.001/10. National Hydrocarbon Commission Determination on the Assessment of Hydrocarbon Exploration and Production Projects

		▪ 2014 Hydrocarbons Law ▪ 2014 Law of the National Agency of Industrial Safety and Environmental Protection in the Hydrocarbons Sector ▪ Contractual Regulations for Acquisitions, Leases, Works, and Services of PEMEX and its Subsidiaries. January 6, 2010
Netherlands	State Supervision of Mines	▪ Mining Decree of Netherlands. January 1, 2003 ▪ Mining Regulation of Netherlands. January 1, 2003 ▪ Mining Act of Netherlands. January 1, 2003, as amended in 2006, 2008, and 2009
New Zealand	WorkSafe New Zealand	Health and Safety in Employment (Exploration and Extraction Regulations) 2013
Norway	Petroleum Safety Authority (PSA)	▪ The Activities Regulations and Guidelines. Amended December 16, 2014 ▪ The Facilities Regulations and Guidelines. Amended December 16, 2014 ▪ The Framework Regulations and Guidelines. Amended May 24, 2013 ▪ The Management Regulations and Guidelines. Amended December 16, 2014 ▪ The Technical and Operational Regulations and Guidelines. Amended December 16, 2014
Russia	▪ Federal Agency for Subsoil Use (Rosendra) ▪ Federal Service for Supervision of Nature Use (Rosprirodnadzor) ▪ Federal, Environmental, Industrial and Nuclear Supervision Service	▪ Subsoil law ▪ Federal law “On Industrial Safety of Hazardous Production Facilities” ▪ Federal law “On Technical Regulation” ▪ Federal Law “On the Continental

	(Rostekhnadzor)	Shelf of the Russian Federation" ▪ Federal Law "On the Exclusive Economic Zone of the Russian Federation" ▪ Safety Regulations for Oil and Gas Industry adopted by RosTechNadzor in 2013 ▪ Safety Regulations in Exploration and Extraction GosGorTechNadzor in 2003 ▪ Industrial Safety Regulations for Oil Processing Works adopted by GosGorTechNadzor in 2003
Trinidad and Tobago	▪ Ministry of Energy and Energy Affairs ▪ Environmental Management Authority	▪ HSE/Measurement Division of the Ministry of Energy and Energy Affairs ▪ Petroleum Act and Regulations ▪ Health, Safety and Environmental (HSE) portfolio relating to 'Prevention and Control' of HSE loss related events
United Kingdom	▪ Department of Energy and Climate Change (DECC) ▪ Health and Safety Executive (HSE)	▪ Offshore Installations (Safety Case) Regulations 2005 ▪ Draft Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations 2015 ▪ Offshore Installations (Prevention of Fire and Explosion, and Emergency Response) Regulations 1995 ▪ Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996 ▪ Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995
United States	▪ Bureau of Safety and Environmental Enforcement ▪ Bureau of Ocean Energy Management	▪ U.S. Code of Federal Regulations Title 30, Chapter II ▪ The Outer Continental Shelf Lands Act
Venezuela	Ministry of Petroleum and Mining	▪ Organic Hydrocarbons Law. May 24, 2006 ▪ Organic Gaseous Hydrocarbons Law.

		May 31, 2000 ▪ 2005 Organic Law of the Ministry of Energy and Petroleum

10.3 Task 1 Summary and Findings

Current Level, Status, and Past of Offshore Exploration and Production

Current and past offshore exploration and production operations vary greatly across priority countries and regional groupings. Some countries/regions have decades of offshore operations with significant prospects for continued successful hydrocarbon exploration and production, such as the Persian Gulf, the Gulf of Mexico, and African nations bordering the Atlantic (including Nigeria and Angola), while other countries/regions have maturing offshore fields and require increased investment in offshore exploration to increase prospective production, such as in Mexico. There are numerous countries that have little to no experience in offshore operations, including several European, African, and Central/South American countries. With regards to priority nations, a majority of the countries have developed, mature offshore industries and some countries are identified as home to some of the most technically challenging offshore environments. Majority of countries with offshore operations have established regulatory frameworks, with varying levels of involvement on the part of all interested entities, including national oil companies, operators, and regulators. Detailed information on offshore discoveries, current and past exploration and production activities, as well as summaries of offshore regulatory bodies/frameworks are located in written country and regional profiles, attached in the Appendix.

Offshore Geological and Geophysical Evaluation

Offshore operations begin with the exploratory phase, in which geologists, geochemists, and geophysicists evaluate and attempt to quantify/characterize potential hydrocarbon-containing areas and reservoirs. The acquisition and analysis of seismic data (two dimensional – 2-D and three dimensional – 3-D) are vital initial processes in exploratory operations. In these operations, large seismic vessels collect subsurface acoustical data which is manipulated to produce detailed subsurface horizontal and vertical slices of offshore hydrocarbon deposits and fields. As a field matures, four dimensional (4-D) seismic data are used to produce time-lapsed analyses of the subsurface showing the effects of reservoir potential. In general major historic offshore hydrocarbon-producing regions and countries continue to attract investments in exploration operations. Top regions of offshore hydrocarbon potential include:

- North Sea
- Gulf of Mexico (U.S. and Mexican region)
- Persian Gulf
- West Africa
- Brazil

In the case of Brazil, there are large pre-salt oil deposits, where hydrocarbon resources are located under especially thick layers of rock and salt[115]. The Arctic is a new frontier of major offshore hydrocarbon potential, and Russia is actively exploring and producing in the region (other countries bordering the Arctic include Denmark, Norway, Canada, and Greenland).

The majority of collected geological and geophysical data are considered proprietary and are not publicly available, although several countries (e.g. the United Kingdom and Norway) release data collected by offshore operators and other companies after the passage of a certain period of time. In Norway, proprietary offshore survey data are released after a range of 2-10 years after their collection. Countries, through governmental scientific/geologic agencies (e.g. the United States Geological Survey – USGS), may also research and perform their own geological investigations and release this information publicly. For example, in Australia, field-level data for geologic formations, water depths, porosity, permeability, and key seismic surveys are summarized for Australia by Geoscience Australia. In Denmark, the Geological Survey of Denmark and Greenland maintains an offshore data which includes interactive maps of 2-D and 3-D seismic data [116]. The USGS has performed an extensive study of world petroleum resources, including offshore areas for many researched countries and regions. This data is available publicly online[117]. Country and regional-specific information on geological and geophysical survey operations are provided in written profiles, attached in the Appendix.

Special Operating Conditions and New Cutting-Edge Technologies Utilized

The type of offshore equipment/infrastructure at a particular offshore installation are dependent on various factors, including reservoir and well characteristics, water/well depths, and other subsea and metocean conditions. New technologies are used across the lifecycle of offshore operations during drilling, production, enhanced recovery, well completion, well workover, and abandonment/decommissioning phases. Examples of newer technologies used in deepwater production operations are subsea production systems. These complex systems involve new design of main components of offshore installations including wells, Christmas trees, manifolds, risers, and controls. The listed examples of identified newer technologies used in the offshore operations of many regions and individual countries are provided in Table 17 below.

Special operating conditions are encountered across world priority countries and regions and can be dependent on individual reservoir/field and well locations. Commonly encountered potentially hazardous special operating conditions include high pressure high temperature (HPHT) environments (pressures exceeding 10,000 psi and temperatures above 300 ° F), hydrogen sulphide presence, deep and ultra-deep water wells, and hazardous metocean/subsea conditions (including hurricane/monsoon weather, waves, earthquakes, and snow/ice/icebergs). HPHT environments are a primary special operating condition, encountered in countries/regions throughout the globe, including the North Sea, the Persian Gulf, the Gulf of Mexico, and Brazil. Generally, regulators across researched countries do not include provisions on special operating conditions (e.g. HPHT) in country statutes/regulations, and offshore operators are responsible for proper planning and actions taken to account for/mitigate any risks posed by these conditions. Further country and regional-specific descriptions of both new/cutting-edge technologies used in offshore operations and special operating conditions are provided written profiles, attached in the Appendix.

Table 17 – Newer Technologies Used in Regional / Country Offshore Operations by Phase of Operation

Offshore E&P Phase	Drilling	Production	Enhanced Recovery	Well Completion	Well Workover	Abandonment/ Decommissioning
List of Technologies	▪ Managed pressure drilling ▪ Surface BOP ▪ Riserless ▪ Extended reach drilling ▪ Horizontal drilling ▪ Multilateral drilling ▪ Slim hole/expandable casing	▪ HIPPS ▪ Subsea separation ▪ Subsea pumping ▪ Subsea flow assurance ▪ Free standing risers ▪ Flexible risers ▪ Composite materials ▪ Dry trees ▪ Subsea tiebacks	▪ Riser base gas lift ▪ Down hole electrical submersible pumps ▪ Mudline boosting ▪ Low cost subsea intervention and workover systems	▪ Horizontal subsea tree ▪ Vertical subsea tree ▪ Smart completions ▪ Multi zone frac packs ▪ Multilateral completions	▪ Coiled tubing intervention ▪ Riserless well intervention ▪ Rig based intervention ▪ Vessel based intervention	▪ Vessel-based operations

Method of Offshore Tender

The term offshore tender describes the legal/regulatory framework used to allocate rights to perform offshore oil/gas activities and own petroleum resources. Three primary methods of tender for offshore operations across researched countries include Production Sharing Agreements (PSAs), Licensing/Concessions, and Technical Service agreements.

- Production sharing agreements are made between national oil companies and other interested oil companies. As part of the agreements, other domestic/international oil companies are granted rights to explore and produce hydrocarbons, though any produced hydrocarbons remain property of the state. The produced hydrocarbons are 'shared' according to terms written in the production sharing contract.
- In license/concession regimes, a nation has primary legal rights to offshore oil and gas resources. The country grants licenses to oil companies to explore for and produce hydrocarbons. In this system, the country with original ownership of the resources receives compensation in the form of taxes and/or royalty payments, which may be based on the amount of hydrocarbons produced.
- Under technical service agreements, national oil companies have the primary right to explore for and produce hydrocarbons in the nation, and agreements with other oil companies are made for specialized services (e.g. drilling), which are typically paid for in cash. The burden of risk in these contracts lies on the national oil company and not on the contracted company. If offshore activities/operations do not result in appreciable produced hydrocarbons, the contracted company will still be paid for the services rendered.

In comparison with the United States, which adheres a licensing/concessions regimes, several countries have adopted elements of multiple tendering methods, such as a combination of PSAs and licensing/concessions. In particular, PSAs are prevalent in countries with little domestic oil production, so that any petroleum produced by international oil companies (IOCs) can help meet the country's petroleum demand. Technical service agreements are the used least for the allocation of offshore oil/gas rights across researched countries. Nations which adhere to this type of tendering system include Saudi Arabia and Venezuela. In countries with established offshore regulatory systems, the regulator plays a major role in administrating offshore tendering contracts, while in countries with NOCs, the NOCs may play the primary role in developing and managing offshore operations by different domestic/international operators and companies. Country and regional-specific descriptions of national offshore tendering systems are provided in the Appendix.

Method of Environmental Analysis across phases of Offshore E&P

The majority of countries analyzed in Task 1 require or suggest a form of environmental analysis, such as an Environmental Impact Assessment (EIA), prior to performance of offshore operations. The primary goal of offshore environmental analyses/studies required by nations is to

ensure that environmental risks and hazards associated with specific operations (e.g. exploration and production) are analyzed and plans are put in place to mitigate potential environmental effects. Some activities analyzed in environmental studies include produced water and drill cuttings discharge as well as the effects of physical stimuli such as noise and light on the marine environment. Various identified governmental and non-governmental organizations supplement national environmental initiatives/regulations enacted by researched countries. One example is the OSPAR Commission, which aims to guide cooperation among 15 European nations in protecting the marine environmental of the North-East Atlantic. OSPAR is active in establishing environmental initiatives to protect the offshore environment and is proactive in staying ahead of environmental concerns associated with the expansion of offshore operations into the Arctic[118]. The efficacy of environmental review/approval of national offshore activities depends on the strength of the offshore regulatory framework for the respective region/country. For example, while the European Union 2013 Offshore Safety Directive mandates environmental assessment of offshore operations, other countries including those in the Persian Gulf, have lesser regulatory provisions on environmental assessment. Though most countries bordering the Gulf have environmental impact assessment requirements, they are upheld more responsively in some countries than in others. Saudi Arabia has an EIA process, but it lacks judicial review and enforcement[119].

Natural Resources and Historical, Socioeconomic and Tribal Issues/Resources

There is an enormous variety and complexity across researched nations in terms of natural and historical, socioeconomic, and tribal issues/resources. In general, most countries have unique marine flora and fauna and other important coastal and submarine resources and artifacts, and many countries have regulatory frameworks in place to protect them. A primary method for resource protection is a classification system used to identify assets/resources with protection priority, such as the Marine Protected Area (MPA) classification system. These systems allow mapping and indexing of protected/potential resources and facilitate inter-regulatory communication between resource conservation regulators and offshore regulatory bodies. In Norway, for example, The Directorate of Cultural Heritage (DCH) is the Ministry of Energy's (MoE's) advisory and executive body for the management of archaeological and architectural monuments and sites, and cultural environments. Their responsibilities include advising the MoE on the implementation of an EIA in relation to heritage issues, to advise regional authorities on questions dealing with new projects, and produce guidelines concerning the use of EIAs in relation to cultural resources[120]. Further details and descriptions of country and regional resources, including maps of Marine Protected Areas (MPAs), are provided in written profiles, attached in the Appendix.

Archaeological, historical, and tribal resources across researched countries include historic coastal towns/infrastructure, shipwrecks, and historical tribal villages and sites. In particular, statutory and regulatory provisions across several researched countries aim to protect tribal heritage, resources, and culture, with specifications on the effects of petroleum exploration and

production. For example, aboriginal groups in Australia have used the Native Title Act to challenge South Australia's government legislation on oil and gas licenses, in response to the state government's amendments to the Petroleum and Geothermal Energy Act, affecting exploration and production licenses.

Oil and gas exploration and production is an important industry across the world, and offshore operations are emphasized as a source of job creation and hydrocarbon independence for numerous researched countries. A primary example source of tension involving nations of several offshore regions are offshore boundary disputes/claim to offshore resources. The South China Sea is a region with highly publicized disputes over offshore resources, where China claims sovereignty over 90% of the area.

10.4 Priority Country and Regional Grouping Data Profile Reports

Attached as separate documents are the completed priority country and regional grouping documents according to Task 1.

10.5 Additional Tables and Figures

Table 18: Priority Country Regulation of Shallow and Deepwater Blowout Preventer (BOP) Requirements

Country	Statutory/regulatory Blowout Preventer (BOP) requirements
Australia	▪ No prescriptive blowout preventer requirements in the Australian petroleum regulatory framework. ▪ Well control is covered in a well operations management plan (WOMP). Operators are required to submit a WOMP to the National Offshore Safety and Environmental Management Authority (NOPSEMA) for acceptance as well as submit a copy to the National Offshore Petroleum Titles Administrator (NOPTA). ▪ NOPSEMA states, "a WOMP should demonstrate that there is a system in place to manage well integrity and well activities for the life of the wells. A WOMP should also include a description of the design, construction, and management of the well activities and a plan for managing the risks associated with the activities in accordance with sound engineering principles and good oil field practice[121]." ▪ A WOMP remains valid for 5 years.
Bahamas	▪ Article 42 of the Bahamian Petroleum Regulations covers the use of blowout equipment in drilling and development operations. Article 42 (1) states, "a licensee or lessee shall take all proper and necessary precautions to combat any possible pressures and for keeping them well under control, including the use of blowout prevention equipment and to prevent the interchange of formation fluids."
Brazil	▪ Blowout preventers are considered critical elements for operational safety in the Brazilian regulatory framework. Brazilian National Petroleum Agency Regulation Number 43 governs performance/goal-based guidelines for safety critical elements of offshore installations.
Canada	▪ Sections 36, and 40-44 of the Canada Oil and Gas Drilling and Production Regulations refer to "kicks" or blowouts. The operator shall ensure that, during all well operations, reliable operating well control equipment is installed to control kicks, prevent blowouts and safely carry out all well activities and operations, including drilling, completion and workover operations. ▪ The operator shall ensure the well and casing are installed at a depth that provides adequate kick tolerances and well control operations that provide for safe, constant bottom hole pressure.
Cuba	In Cuba, blowout preventer (BOP) system reporting/documentation requirements are addressed in Part III of the 2010 regulation: "Preparation of Safety Case Reports for Offshore Oil/Gas Well Drilling Installations." Blowout preventer requirements to be listed in the health, safety, and environment (HSE) case include ratings of BOP and BOP control systems, statement that BOP and control system were designed according to American Petroleum Institute (API) standard 6A or 16D, or equivalent, confirmation that the BOP system is maintained according to API standard RP 53 or

Country	Statutory/regulatory Blowout Preventer (BOP) requirements
	equivalent, diverter system details and affirmation that it was designed according to API standard 16D or equivalent, information on control systems that vent control fluid to the marine environment, and if applicable: arrangement details for managed pressure drilling (MPD) systems, High Pressure High Temperature (HPHT) systems, and surface BOP.
Denmark/ Greenland	▪ Blowout preventer (BOP) requirement information submitted to the Working Environment Authority as part of the Drilling Programme includes: ○ List of blowout prevention equipment located on the platform (specifying manufacturer, size, working pressure, and arrangement), information on the BOP control system; " a list of the blowout prevention equipment available on the drill floor ready for mounting on the drill pipe[122]." ○ Kick control procedures ("the data and calculations which by routine are updated to ensure the necessary background for handling emergency situations[123],") and information on how BOPs, measurement equipment, and drilling fluid circulation and mixing equipment will function under conditions creating a kick; ○ A "programme for drills in connection to the equipment"; and a testing program for blowout preventers and casing at different stages of drilling operations. Blowout preventer set-up specified by the Danish Energy Agency (now Working Environment Agency) includes installation of the blowout preventer prior to installation of the surface casing. The blowout prevention system is to consist of at least one annual preventer containing at least one set of pipe rams and one set of blind or shear type blind rams together with kill and choke lines connected to the choke manifold. All rams and connections are to function and be pressure tested according to the approval of the Danish Energy Agency (now Working Environment Agency). ▪ In Greenland, BOP preventer system requirements are addressed in the Greenland Bureau of Minerals and Petroleum Drilling Guidelines. The Guidelines state that BOP systems must consist of a minimum of "two pipe shear rams, comprising 1 blind shear and 1 casing shear ram[124]." Additional blowout preventer system guidance states "the control BOP Control System shall in addition to the regulator control system of a Remotely Operated Acoustic Control System for emergency situations." On mobile offshore drilling units (MODUs), the BMP also states that "dependent on the age, state of conditions, historical and maintenance records among others, BMP may request a full third party review and reassessment of the complete Well Control System onboard the MODU prior to commencement of drilling operations[125]." A drilling program submitted to the BMP must also contain ○ A list of BOP equipment available at a MODU (including manufacturer, size, pressure and arrangement); ○ Procedures for kick control and how BOP equipment will respond to these conditions; ○ Description of drilling procedures with BOP equipment;

Country	Statutory/regulatory Blowout Preventer (BOP) requirements
	○ Description of the program for pressure testing BOP and casing at different stages in drilling operations. Disassembly or maintenance of blowout preventers can only occur when the well is secured by two independent and tested barriers, generally or specifically accepted by the BMP.
Iceland	No blowout preventer permitting/monitoring requirements/guidance addressed in reviewed Icelandic petroleum regulations: Act Number 13 (2001), "On Prospecting, Exploration, and Production of Hydrocarbons." or Regulation Number 884 (2011), "On Prospecting, Exploration and Production of Hydrocarbons."
Jamaica	No blowout preventer permitting/monitoring requirements/guidance addressed in the Jamaican petroleum regulatory framework.
Mexico	▪ Statutory/regulatory requirements establish that PEMEX must have internal standards for blowout preventer equipment used in deepwater operations. ▪ This is different from prescriptive permitting/monitoring by regulatory authorities, where operations monitoring/permitting requirements established by the regulators are written in statutory law and/or regulations. National Hydrocarbon Commission Resolution 12.001/10, Article 46, Section IX, states that PEMEX must have internal standards for Blowout Preventers which incorporate industry best practices for testing Blowout Preventers during drilling, well testing, completion, and well repair and work over activities. Resolution 12.001/10, Article 46, Section IX, subsections a-g also provide additional specifications regarding blowout Preventer design standards and monitoring, including having remotely operated vehicles with capabilities to operate all subsea control systems, establishing verification protocols for proper operation and sealing of blowout preventers, well pressure testing, reviewing existing standards, verifying that manufacturers follow the latest standards, verifying that new elements in blowout preventer design increase reliability and safety, and proper design of blowout preventer arrangement[126]. ▪ National Hydrocarbon Commission Resolution 12.001/10, Article 46, Sections XI-XIII also provide further specifications for Blowout Preventer operation, including equipment performance, maintenance, and personnel training. Regulatory designations include mandatory internal procedures and mechanism for third party testing (Section XI, subsection d); process for inspection and certification of blowout preventers every five years (Section XI, subsections a-e); and a training program (Section XIII)[127].
Netherlands	▪ Prescriptive well control/blowout preventer system requirements are outlined in Articles 8.3.1.2 through 8.3.3.2 of the Mining Regulation; including blowout prevention system equipment; operation procedures, and testing requirements and guidelines[128].
New Zealand	▪ New Zealand follows a safety case regime and do not have specific regulations/requirements governing Blowout Preventers. Separately, a certificate of fitness is issued for each offshore installation with an approved safety case.

Country	Statutory/regulatory Blowout Preventer (BOP) requirements
	Certificates of fitness verify compliance with a safety case and "demonstrate that the installation's structure and all equipment necessary for the safe operation of the installation are appropriately designed, are in good working order and in a good state of repair." ▪ An installation's safety case will list all structures and equipment required for the safe operation of the installation. A certificate of fitness is valid for five years, and it must be re-issued after five years by a recognized inspection body. "If the structure or equipment required for an installation's safe operation no longer complies with its existing certificate of fitness, the duty holder must cease operation of all the affected structure or equipment[129]." ▪ "When the duty holder modifies or replaces part of all of the installation's structure or equipment necessary for its safe operation, including software revisions for programmable devices, the installation's certificate of fitness is no longer current," and a new certificate of fitness must be issued by an inspection body.
Norway	▪ Well control performance standards are addressed in Chapter VIII of the Norwegian Facilities Regulations (Sections 49). Regarding well control equipment, the regulation states, "Well control equipment shall be designed and capable of activation such that it ensures both barrier integrity and well control. For drilling of top hole sections through risers or conductors, equipment shall be installed with a capacity to divert shallow gas and formation fluids away from the facility until the personnel have been evacuated. The pressure control equipment used in well interventions shall have remote-controlled valves and mechanical locking mechanisms in the closed position. Well intervention equipment shall have a remote-controlled shear/blind ram as close to the Christmas tree as possible. Floating facilities shall have an alternative activation system for activating critical functions on the blowout preventer for use in the event of an evacuation. Floating facilities shall also have the capacity to disconnect the riser package after the shear ram has cut the work string[130]." ▪ Regulatory requirements for blowout preventer testing is covered in Section 51 of the Norwegian Activities Regulations, issued by the Petroleum Safety Authority, Norwegian Environment Agency, Norwegian Directorate of Health, and the Norwegian Food Safety Authority. The regulation states, "the blowout preventer with associated valves and other pressure control equipment on the facility shall be pressure tested and function tested, [according to performance-based maintenance programme guidelines established in Sections 45 and 47 of the same regulation]. The blowout preventer with associated valves and other pressure control equipment on the facility shall undergo a complete overhaul and recertification every five years[131]."
Russia	▪ General guidelines are given by regulatory authorities to ensure blowout prevention and the mitigation of associated accidents in the subsoil areas of federal importance. For example, the License Owner shall enter into an agreement

Country	Statutory/regulatory Blowout Preventer (BOP) requirements
	with a specialized organization to prevent blowouts. ▪ More specific requirements for blowout preventers are contained within the law "GOST 12.2.115-86 Blowout Preventer equipment safety requirements[132]." In general, requirements are not prescriptive or technical in nature. For example, monitoring and compliance requirements are specified to allow for in field routine testing in addition to factory acceptance tests.
Trinidad and Tobago	No blowout preventer permitting/monitoring requirements/guidance addressed in Trinidad and Tobago's statutory/regulatory petroleum framework.
United Kingdom	▪ There are no significant prescriptive blowout preventer requirements in the United Kingdom offshore upstream petroleum operations regulations. ▪ Blowout preventers are considered safety critical elements (SCEs) in the UK's safety case regime. All SCEs are identified in the safety case and duty holders (installation owners/operators) must appoint an independent organization as "Verifier" of SCEs. A Verification Scheme, or document which ensures that SCEs at an installation are suitable, or appropriate for intended use, dependable and effective when required, and able to perform as intended. The Verification Scheme should provide independent review/inspection to establish continued effectiveness throughout an installation's lifecycle, and be updated when industry standards/technology/knowledge change; it must be shown that all SCEs are suitably designed/constructed and will be properly maintained. ▪ Safety Critical Elements must have detailed Performance Standards (PSs), defined as "a statement, which can be expressed in qualitative or quantitative terms, of the performance required of a system, item of equipment, person or procedure, and which is used as the basis for managing the hazard, e.g. planning, measuring, control, or audit - through the lifecycle of the installation."
United States	▪ The general requirements for BOP systems and system components is that the operator must design, install, maintain, test, and use the BOP system and system components to ensure well control. The working-pressure rating of each BOP component must exceed maximum anticipated surface pressures. ▪ Two sets of requirements are listed for surface BOP stacks and subsea BOP systems, but there are no specific requirements for shallow water vs. deepwater conditions. The BOP systems must include associated systems and related equipment, choke manifolds that follow certain requirements, and kelly valves, inside BOPs, and drill-string safety valves requirements. BOP maintenance and inspection requirements are also listed in Section 250.446[133]. ▪ The operator must document how the provisions were met or exceeded and the records must be made available to BSEE upon request. There are also BOP pressure test requirements. For completion operation, the operator's

Country	Statutory/regulatory Blowout Preventer (BOP) requirements
	Application for Permit to Modify (APM) must include certain BOP descriptions. ▪ There are guidelines for blowout prevention equipment, blowout prevent system tests, inspections, and maintenance, and tubing and wellhead equipment. There are also guidelines on BOP information that must be submitted for well-workover operations, system testing, records, and drills, NOP inspection and maintenance requirements, tubing and wellhead equipment, and wireline operations to minimize leakage of well fluids. There are guidelines outlining the blowout preventer systems and system components and blowout preventer systems tests, actuations, inspections, and maintenance.
Venezuela	Venezuelan offshore upstream petroleum regulations do not address permitting or monitoring of blowout preventers.

Table 19 – Priority Country Regulation of Shallow and Deepwater Cementing Operations

Country	Statutory/regulatory cementing operations requirements
Australia	▪ No significant permitting/monitoring of cementing operations in the Australian petroleum regulatory framework. An initial well completion report is due to the Title Administrator containing information on cementing operations and schematics for well abandonment.
Bahamas	▪ No significant permitting/monitoring of cementing operations in the Bahamian petroleum regulatory framework. Article 41 of the Bahamian Petroleum Regulations covers cementing of casing strings in offshore drilling and development operations. The Article states, "sufficient casing strings shall be run and cemented in all wells so as to protect adequately against the contamination of water, to provide a secure base for blowout prevention equipment and to prevent interchange of formation fluids."
Brazil	▪ No prescriptive cementing requirements are addressed in the Brazilian regulatory framework. According to the definition provided in the Brazilian Operational Safety Management System (Regulation Number 43/2007), cementing operations are considered safety critical elements of an offshore installation.
Canada	▪ The operator shall ensure that the well and casing are designed so that the well can be drilled safely, the targeted formations evaluated and waste prevented; the anticipated conditions, forces and stresses that may be placed upon them are withstood; and the integrity of gas hydrate and permafrost zones. ▪ The operator shall ensure that the well and casing are installed at a depth that provides for adequate kick tolerances and well control operations that provide for safe, constant bottom hole pressure. ▪ The operator shall ensure that cement slurry is designed and installed so that the movement of formation fluids in the casing annuli is prevented and, where required for safety, resource evaluation or prevention of waste, the isolation of the oil, gas and water zones is ensured; support for the casing is provided; corrosion of the casing over the cemented interval is retarded; and the integrity of gas hydrate and permafrost zones — and, in the case of an onshore well, potable water zones — is protected. ▪ After the cementing of any casing or casing liner and before drilling out the casing shoe, the operator shall ensure that the cement has reached the minimum compressive strength sufficient to support the casing and provide zonal isolation. ▪ After installing and cementing the casing and before drilling out the casing shoe, the operator shall ensure that the casing is pressure-tested to the value required to confirm its integrity for maximum anticipated operating pressure.
Cuba	▪ Cementing system reporting/documentation requirements are addressed in Part III of the 2010 regulation: "Preparation of Safety Case Reports for Offshore Oil/Gas Well Drilling Installations." Cement system items to be

Country	Statutory/regulatory cementing operations requirements
	included in the health, safety, and environment (HSE) case are: a description (with rating/capacities) and relevant standards for cement unit interfaces, a line drawing of the cement system, and arrangements for reviewing/approving the status/condition of 3rd party cement units.
Denmark/ Greenland	▪ In Denmark, cementing operations activities and reporting requirements (irrespective of deep- and shallow-water classification) are addressed in a Drilling Programme. Specifications/guidance topics addressed include performance of a cement hardening test, cement specification for casing placement (including cement type and volume), cement bond logging and temperature surveys, and cement plugging for well abandonment activities. ▪ Greenland's Bureau of Minerals and Petroleum (BMP) issues requirements/guidance on cementing operations in its Exploration Drilling Guidelines. Guidance includes that cement bond logs or temperature surveys are performed when critical tops of cement (TOCs) are required for intermediate and production casing isolation and production casing and liners are checked with cement bond logging in circumstances where an incomplete job is suspected. ▪ The BMP also issues requirements on cementing operations as part of suspension/abandonment operations, including cement placement and weight.
Iceland	▪ No cementing operations permitting/monitoring requirements/guidance addressed in Iceland's statutory/regulatory offshore petroleum framework. ▪ The regulator (National Energy Authority) regulates cementing operations through performance-based guidelines and through review and approval of field development and production plans.
Jamaica	No cementing operations permitting/monitoring requirements/guidance addressed in the Jamaica's statutory/regulatory petroleum framework.
Mexico	▪ Statutory/regulatory requirements establish that PEMEX must have internal standards for cementing operations in deepwaters. This is different from prescriptive permitting/monitoring by regulatory authorities, where operations monitoring/permitting requirements established by the regulators are written in statutory law and/or regulations. ▪ In Mexico, the National Hydrocarbon Commission Resolution 12.001/10, Article 46, Section XIV states that PEMEX must have an internal regulation for mechanisms and procedures for items including evaluation of cement quality and integrity tests (especially with respect to exposure to high temperature and pressure), as well as best techniques for cement qualitative and quantitative evaluation.
Netherlands	▪ No extensive cement reporting requirements/specifications are addressed in Dutch petroleum regulations, though in the "Work Programme for construction of boreholes," operators must provide "details of the cementing of each casing series to be applied, with details of the planned depth from the top of the annular cement column." (Article 8.2.1.1 of the Dutch Mining Regulation)[134].

Country	Statutory/regulatory cementing operations requirements
	▪ The work programme is required to be submitted to the State Supervision of Mines at least four weeks prior to commencement of well operations. Cementing operations are also considered in separate reports for well repair and decommissioning, titled, respectively, "work programme for the repair of wells" and "work programme for decommissioning of wells." ▪ Required details to be included in these reports include "details of the cementing of each casing series to be applied, with details of planned depth from the top of the annular cement column [well repair]" and drawings of "cementing depth and depth to the top of the annual cement columns [well decommissioning]." - (Mining Regulation Articles 8.2.3.1 and 8.2.4.1)[135]
New Zealand	▪ New Zealand follows a safety case regime and do not have specific regulations/requirements governing Cementing Operations. A certificate of fitness is issued for each offshore installation with an approved safety case. Certificates of fitness verify compliance with a safety case and "demonstrate that the installation's structure and all equipment necessary for the safe operation of the installation are appropriately designed, are in good working order and in a good state of repair." "An installation's safety case will list all structures and equipment required for the safe operation of the installation." ▪ A certificate of fitness is valid for five years, and must be re-issued after five years by a recognized inspection body. "If the structure or equipment required for an installation's safe operation no longer complies with its existing certificate of fitness, the duty holder must cease operation of all the affected structure or equipment." ▪ "When the duty holder modifies or replaces part of all of the installation's structure or equipment necessary for its safe operation, including software revisions for programmable devices, the installation's certificate of fitness is no longer current," and a new certificate of fitness must be issued by an inspection body.
Norway	▪ Cementing unit performance standards are addressed in Chapter VIII, Section 52 of the Norwegian Facilities Regulations. This section states "the cementing unit shall be designed such that it mixes, stores, and delivers the correct volume of cement with necessary properties to ensure proper anchoring and barrier integrity. The unit shall be designed such that the residues of both unmixed chemicals and mixed cement are handled in accordance with the principles of the Pollution Control Act (in Norwegian only). In the event the cementing unit with associated systems shall function as a replacement unit for the drilling fluid system, it shall have sufficient capacity and working pressure to be able to control the well pressure at all times[136]."
Russia	There is no distinguishing made between requirements in shallow vs. deepwater based on information in the public domain.
Trinidad	▪ No cementing operations permitting/monitoring requirements/guidance addressed in Trinidad and Tobago's

Country	Statutory/regulatory cementing operations requirements
and Tobago	statutory/regulatory petroleum framework.
United Kingdom	▪ There are no significant prescriptive cementing operations requirements in the United Kingdom offshore upstream petroleum operations regulations. Cementing operations are considered safety critical elements (SCEs) in the UK's safety case regime. ▪ All SCEs are identified in the safety case and duty holders (installation owners/operators) must appoint an independent organization as "Verifier" of SCEs. A Verification Scheme, or document which ensures that SCEs at an installation are suitable, or appropriate for intended use, dependable and effective when required, and able to perform as intended. ▪ The Verification Scheme should provide independent review/inspection to establish continued effectiveness throughout an installation's lifecycle, and be updated when industry standards/technology/knowledge change; it must be shown that all SCEs are suitably designed/constructed and will be properly maintained. Safety Critical Elements must have detailed Performance Standards (PSs), defined as "a statement, which can be expressed in qualitative or quantitative terms, of the performance required of a system, item of equipment, person or procedure, and which is used as the basis for managing the hazard, e.g. planning, measuring, control, or audit - through the lifecycle of the installation."
United States	▪ All wells must be cased, cemented, and meet the requirements of sections 250.4221 - 250.428. The casing and cementing programs must properly control formation pressures and fluids, prevent the direct or indirect release of fluids from any stratum through the wellbore into offshore waters and prevent communication between separate hydrocarbon-bearing strata. The casing and cementing programs must also protect freshwater aquifers from contamination, support unconsolidated sediment, and include a certification signed by a registered professional engineer that the casing and cementing design is appropriate for the purpose for which it is intended under expected wellbore conditions, and is sufficient to satisfy the test and requirements and section 250.420 and 250.423. ▪ Section 250.421 identifies specific design, setting, and cementing requirements for casing strings and liners. Section 250.422 describes when drilling can be resumed after cementing. ▪ Section 250.423 describes the minimum test pressure for each string or casing. Section 250.424 describes the requirements for prolonged drilling operations (more than 30 days). Section 250.425 describes the requirements for pressure testing liners, while Section 250.426 describes the recordkeeping requirements for casing and liner pressure tests. ▪ Section 250.427 describes the requirements for pressure integrity tests, and the last section (250.428) describes actions that lessees must take when certain situations occur during casing and cementing activities. There are

Country	Statutory/regulatory cementing operations requirements
	guidelines on what the casing and cementing programs must include (250.415).
Venezuela	No cementing operations permitting/monitoring requirements/guidance addressed in Venezuela's statutory/regulatory petroleum framework.

Table 20 – Priority Country Regulation of Shallow and Deepwater Remotely Operated Vehicle (ROV) Requirements

Country	Statutory/regulatory cementing operations requirements
Australia	Australia's offshore upstream petroleum regulations do not address permitting or monitoring of remotely operated vehicles (ROVs).
Bahamas	Bahamian offshore upstream petroleum regulations do not address permitting or monitoring of remotely operated vehicles (ROVs).
Brazil	Remotely operated vehicles (ROVs) are used in offshore operations, with an emphasis on environmental considerations (e.g. identification of deepwater coral and algae prior to commencement of drilling and production activities), though there is no regulatory/statutory basis for the use of ROVs.
Canada	Canada's offshore upstream petroleum regulations do not address permitting or monitoring of remotely operated vehicles (ROVs).
Cuba	Operator ROV monitoring requirements are addressed in Part III of the 2010 regulation: "Preparation of Safety Case Reports for Offshore Oil/Gas Well Drilling Installations." Section 3.10 of the regulation states operators should reference the procedures for reviewing/approving the status/condition of 3rd party ROV units, as well as a description of any risk assessment performed.
Denmark	Denmark's offshore upstream petroleum regulations do not address permitting or monitoring of remotely operated vehicles (ROVs).
Greenland	Greenland's offshore upstream petroleum regulations do not address permitting or monitoring of remotely operated vehicles (ROVs).
Iceland	Iceland's offshore upstream petroleum regulations do not address permitting or monitoring of remotely operated vehicles (ROVs).
Jamaica	Jamaican offshore upstream petroleum regulations do not address permitting or monitoring of remotely operated vehicles (ROVs).
Mexico	National Hydrocarbon Commission Resolution 12.001/10, Article 46, Section XVI, states PEMEX should have mechanisms and procedures in place for remotely operated vehicle (ROV), for items including selection of appropriate ROVs, evaluation of use of ROVs in emergencies and contingencies, personnel training in ROV use, and third party certification of ROVs.
Netherlands	Dutch offshore upstream petroleum regulations do not address permitting or monitoring of remotely operated vehicles (ROVs).
New	New Zealand follows a safety case regime and do not have specific regulations/requirements governing remotely

Zealand	operated vehicles.
Norway	Norwegian offshore upstream petroleum regulations do not address permitting or monitoring of remotely operated vehicles (ROVs).
Russia	There is no differentiation made between requirements in shallow vs. deepwater based on information in the public domain.
Trinidad and Tobago	Trinidad and Tobago's offshore upstream petroleum regulations do not address permitting or monitoring of remotely operated vehicles (ROVs).
United Kingdom	United Kingdom follows a safety case regime and offshore upstream petroleum regulations do not address permitting or monitoring of remotely operated vehicles (ROVs).
United States	Section 250.1740 describes how the operator must verify that the site of a permanently plugged well, removed platform, or other removed facility is clear of obstructions. One of the methods is that the operator videotape the site using a camera on a ROV. The ROV camera must record/videotape over 100 percent of the appropriate grid area listed in 250.1741(a) and the ROV must use a pattern of concentric circles or parallel lines spaced no more than 10 feet apart. 250.442 lists requirements for a subsea BOP system and requirement (d) is to have a subsea BOP stack equipped with ROV intervention capability. At minimum, the ROV must be capable of closing one set of pipe rams, closing one set of blind-shear rams and unlatching the Lower Marine Riser Package (LMRP).
Venezuela	Venezuelan offshore upstream petroleum regulations do not address permitting or monitoring of remotely operated vehicles (ROVs).

10.6 References

[1] UK HSE. The Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations 2015: Guidance on Regulations. Available online at: http://www.hse.gov.uk/pubns/priced/l154.pdf

[2] UK HSE. Offshore Oil and Gas Sector Strategy. Available online at: http://www.hse.gov.uk/offshore/offshore-oil-and-gas.pdf

[3] Government of Jamaica Legislation Programme 2010/2011. Available at: http://www.cabinet.gov.jm/files/GOJ%20Legislation%20Programme%202010-2011.pdf

[4] Iceland Act Number 13: "On Prospecting, Exploration, and Production of Hydrocarbons." Available online at: http://www.nea.is/media/2nd-round/Act-No-13-2001-03102011.pdf

[5] International Association of Oil and Gas Producers. Report No. 2013s. "Safety Performance Indicators – 2013 Data." Available online at: http://www.iogp.org/pubs/2013s.pdf

[6] Working Environmental website. "Installation Integrity" Accessed at: http://engelsk.arbejdstilsynet.dk/en/offshore/installation-integrity.aspx

[7] Information on 'Consents' available at the Petroleum Safety Authority website. Accessed at: http://www.psa.no/about-consents/category949.html

[8] United Kingdom government website. "Oil and gas: operatorship." Accessed at: https://www.gov.uk/oil-and-gas-operatorship

[9] United Kingdom Health and Safety Executive website: "Understanding oil and gas wells notifications." Accessed at: http://www.hse.gov.uk/foi/internalops/hid_circs/technical_osd/spc_tech_osd_45.htm

[10]Australia Offshore Petroleum and Greenhouse Gas Storage Act. Available for download here: http://www.nopsema.gov.au/legislation-and-regulations/

[11] Consolidated Act on Safety, etc. for Offshore Installations for Exploration, Extraction and Transport of Hydrocarbons (Offshore Safety Act). Part III. Available online at: http://goo.gl/sG5EAM

[12] National Hydrocarbons Commission Regulation 06.002/09. Article 12.9. Entire regulation available online (in Spanish at): http://dof.gob.mx/nota_detalle_popup.php?codigo=5125653

[13] New Zealand Health and Safety in Employment (Petroleum Exploration and Extraction) Regulations 2013. Part 1. Available online at: http://www.legislation.govt.nz/regulation/public/2013/0208/latest/whole.html?search=sw_096be8ed80ecff88_permit_25_se&p=1#DLM5203535

[14] United States Code of Federal Regulations. Title 30, Chapter II, Subchapter B, Part 250-Oil and Gas and Sulphur Operations in the Outer Continental Shelf. Available online at: http://www.ecfr.gov/cgi-bin/text-idx?SID=a1bb933e15dd1521ab1af7fab36cac45&node=pt30.2.250&rgn=div5#sp30.2.250.c

[15] Global Wells Organization. BP. "Real-Time Monitoring Capability." Available online at: http://www.bsee.gov/Technology-and-Research/Technical-Forums/Panel4_Abbassian/

[16] Regulations Relating to Management and the Duty to Provide Information in the Petroleum Activities and at Certain Onshore Facilities (The Management Regulations). Available online at: http://www.psa.no/getfile.php/Regelverket/Styringsforskriften_e.pdf

[17] Norway PSA website. "Major Accident Risk." Accessed online at: http://www.psa.no/major-accident-risk/category1030.html

[18] Australia Offshore Petroleum and Greenhouse Gas Storage Act. Available for download here: http://www.nopsema.gov.au/legislation-and-regulations/

[19] NOPSEMA. Management of Offshore Well Operations Plan: Interim Guidelines. Available online at: http://www.nopsema.gov.au/assets/Guidelines/N-04600-GL0936-Management-of-Offshore-Well-Operations-Plans-Interim-Guideline.pdf

[20] Greenland Mineral Resources Act (unofficial translation). Article 79. Available online at: http://www.govmin.gl/images/stories/faelles/mineral_resources_act_unofficial_translation.pdf

[21] Greenland Mineral Resources Act (unofficial translation). Article 79. Available online at: http://www.govmin.gl/images/stories/faelles/mineral_resources_act_unofficial_translation.pdf

[22] Act Number 13. "On Prospecting, Exploration and Production of Hydrocarbons." Article 10. Available online: http://www.nea.is/media/olia/Act-No-13-2001-14102014.pdf

[23] Mining Regulation of the Netherlands available online at: http://www.nlog.nl/resources/Legislation/MBREnglishAug%2009.pdf

[24] New Zealand Health and Safety in Employment (Petroleum Exploration and Extraction) Regulations 2013. Part 1. Available online at: http://www.legislation.govt.nz/regulation/public/2013/0208/latest/whole.html?search=sw_096be8ed80ecff88_permit_25_se&p=1#DLM5203535

[25] New Zealand Health and Safety in Employment (Petroleum Exploration and Extraction) Regulations 2013. Part 1. Available online at: http://www.legislation.govt.nz/regulation/public/2013/0208/latest/whole.html?search=sw_096be8ed80ecff88_permit_25_se&p=1#DLM5203535

[26] Norwegian "Facilities Regulations." Entire regulation available online at: http://www.psa.no/getfile.php/Regelverket/Innretningsforskriften_e.pdf

[27] Norwegian Management Regulations. Available online at: http://www.psa.no/getfile.php/Regelverket/Styringsforskriften_e.pdf

[28] Norwegian Management Regulations. Available online at: http://www.psa.no/getfile.php/Regelverket/Styringsforskriften_e.pdf

[29] Regulations Relating to Management and the Duty to Provide Information in the Petroleum Activities and at Certain Onshore Facilities (the Management Regulations). Available online at: http://www.psa.no/pdfs-of-regulations/category934.html

[30] Regulations Relating to Management and the Duty to Provide Information in the Petroleum Activities and at Certain Onshore Facilities (the Management Regulations). Available online at: http://www.psa.no/pdfs-of-regulations/category934.html

[31] Information on verification schemes available at the UK HSE website. Accessed at: http://www.hse.gov.uk/foi/internalops/hid_circs/enforcement/spcenf174.htm

[32] UK HSE website. "Well examination schemes- commonly observed weaknesses." Accessed online at: http://www.hse.gov.uk/foi/internalops/hid_circs/technical_osd/spc_tech_osd_43.htm

[33] United States Code of Federal Regulations. Title 30, Chapter II, Subchapter B, Part 250-Oil and Gas and Sulphur Operations in the Outer Continental Shelf. Available online at: http://www.ecfr.gov/cgi-bin/text-idx?SID=a1bb933e15dd1521ab1af7fab36cac45&node=pt30.2.250&rgn=div5#sp30.2.250.c

[34] U.S. Federal Code of Regulations Title 30. Regulation available online at: http://www.ecfr.gov/cgi-bin/text-idx?SID=a1bb933e15dd1521ab1af7fab36cac45&node=pt30.2.250&rgn=div5#sp30.2.250.c

[35] U.S. Federal Code of Regulations Title 30. Regulation available online at: http://www.ecfr.gov/cgi-bin/text-idx?SID=a1bb933e15dd1521ab1af7fab36cac45&node=pt30.2.250&rgn=div5#sp30.2.250.c

[36] Venezuelan Organic Hydrocarbons Law. Article 19. Available online (in Spanish) at: http://www.mpetromin.gob.ve/repositorio/imagenes/file/normativas/leyes/LEY_ORGANICA_DE_HIDROCARBUROS_CORREGIDA.pdf

[37] NOPSEMA Guidance Notes. "Notification and Reporting of Accidents and Dangerous Occurrences." Available online at: http://www.nopsema.gov.au/assets/Guidance-notes/N-3000-GN0099-Notification-and-Reporting-of-Accidents-and-Dangerous-Occurrences-July-2013.pdf

[38] NOPSEMA Guidance Notes. "Notification and Reporting of Accidents and Dangerous Occurrences." Available online at: http://www.nopsema.gov.au/assets/Guidance-notes/N-3000-GN0099-Notification-and-Reporting-of-Accidents-and-Dangerous-Occurrences-July-2013.pdf

[39] Canada Oil and Gas Drilling and Production Regulations. Page 8. Available online at: http://laws-lois.justice.gc.ca/eng/regulations/SOR-2009-315/

[40] Canada Oil and Gas Drilling and Production Regulations. Pages 11-12. Available online at: http://laws-lois.justice.gc.ca/eng/regulations/SOR-2009-315/

[41] Canada Oil and Gas Drilling and Production Regulations. Page 21. Available online at: http://laws-lois.justice.gc.ca/eng/regulations/SOR-2009-315/

[42] Working Environmental Authority website. Accessed online at: http://engelsk.arbejdstilsynet.dk/en/offshore/injuries-nearmisses-etc.aspx

[43] Regulation Number 884: "On Prospecting, Exploration, and Production of Hydrocarbons." – Unofficial Translation. Available online at: http://www.nea.is/media/olia/Regulation-884-2011-03102011.pdf

[44] Dutch Mining Regulation. Available online at: http://www.sodm.nl/english/legislation-and-regulations

[45] Netherlands Oil and Gas Producers Association (NOGEPA) Guideline Number 5: Mining Activities – Reporting Accidents and Incidents. Available online at: http://www.nogepa.nl/download-guidelines/

[46] Regulations Relating to Management and the Duty to Provide Information in the Petroleum Activities and at Certain Onshore Facilities (the Management Regulations). Available online at: http://www.psa.no/pdfs-of-regulations/category934.html

[47] Regulations Relating to Management and the Duty to Provide Information in the Petroleum Activities and at Certain Onshore Facilities (the Management Regulations). Available online at: http://www.psa.no/pdfs-of-regulations/category934.html

[48] Regulations Relating to the Design and Outfitting of Facilities, etc., in the Petroleum Activities (The Facilities Regulations). Page 14. Available online at: http://www.psa.no/pdfs-of-regulations/category934.html

[49] Regulations Relating to the Design and Outfitting of Facilities, etc., in the Petroleum Activities (The Facilities Regulations). Page 14. Available online at: http://www.psa.no/pdfs-of-regulations/category934.html

[50] Regulations Relating to the Design and Outfitting of Facilities, etc., in the Petroleum Activities (The Facilities Regulations). Page 15. Available online at: http://www.psa.no/pdfs-of-regulations/category934.html

[51] Regulations Relating to the Design and Outfitting of Facilities, etc., in the Petroleum Activities (The Facilities Regulations). Page 15. Available online at: http://www.psa.no/pdfs-of-regulations/category934.html

[52] Norwegian Facilities Regulations. Available online at: http://www.psa.no/getfile.php/Regelverket/Innretningsforskriften_e.pdf

[53] Government of the Russian Federation Decree On the Unified Governmental System for Prevention and Response to Emergency Situations (in Russian). Available online at: http://www.g20gmep.org/wp-content/uploads/Appendix-28-Government-of-the-Russian-Federation-Decree-on-the-Unified-Governmental-System-for-Prevention-and-Response-RU.pdf

[54] United Kingdom Reporting of Injuries, Disease, and Dangerous Occurrences Regulations 2013 (RIDDOR). Available online at: http://www.hse.gov.uk/riddor/

[55] http://www.hse.gov.uk/contact/raising-your-concern.htm

[56] UK 2015 Offshore Safety Case Regulations. Regulation 33. Available online at: http://www.hse.gov.uk/offshore/assets/pdfs/safety-case-regs.pdf

[57] United Kingdom Health and Safety Executive website. “Verification that safety critical elements are ‘suitable’ at the commencement of a verification scheme” Accessed at: http://www.hse.gov.uk/foi/internalops/hid_circs/enforcement/spcenf174.htm

[58] U.S. Federal Code of Regulations Title 30. Section 250.107. Regulation available online at: http://www.ecfr.gov/cgi-bin/text-idx?SID=a1bb933e15dd1521ab1af7fab36cac45&node=pt30.2.250&rgn=div5#sp30.2.250.c

[59] U.S. Federal Code of Regulations Title 30. Regulation available online at: http://www.ecfr.gov/cgi-bin/text-idx?SID=a1bb933e15dd1521ab1af7fab36cac45&node=pt30.2.250&rgn=div5#sp30.2.250.c

[60] U.S. Federal Code of Regulations Title 30. Regulation available online at: http://www.ecfr.gov/cgi-bin/text-idx?SID=a1bb933e15dd1521ab1af7fab36cac45&node=pt30.2.250&rgn=div5#sp30.2.250.c

[61] U.S. Federal Code of Regulations Title 30. Regulation available online at: http://www.ecfr.gov/cgi-bin/text-idx?SID=a1bb933e15dd1521ab1af7fab36cac45&node=pt30.2.250&rgn=div5#sp30.2.250.c

[62] Venezuelan Organic Law on Gaseous Hydrocarbons. Available online (in Spanish) at: http://www.mpetromin.gob.ve/repositorio/imagenes/file/normativas/leyes/Reglamento_de_la_Ley_Organica_de_Hidrocarburos_Gaseosos.pdf

[63] Regulations Relating to Management and the Duty to Provide Information in the Petroleum Activities and at Certain Onshore Facilities (The Management Regulations). Available online at: http://www.psa.no/getfile.php/Regelverket/Styringsforskriften_e.pdf

[64] Netherlands Oil and Gas Producers Association (NOGEPA) Guideline Number 5: Mining Activities – Reporting Accidents and Incidents. Available online at: http://www.nogepa.nl/download-guidelines/

[65] New Zealand Health and Safety in Employment (Petroleum Exploration and Extraction) Regulations 2013. Available online at: http://www.legislation.govt.nz/regulation/public/2013/0208/15.0/DLM5203558.html

[66] New Zealand Health and Safety in Employment (Petroleum Exploration and Extraction) Regulations 2013. Available online at: http://www.legislation.govt.nz/regulation/public/2013/0208/15.0/DLM5203558.html

[68] Government of the Russian Federation Decree On the Unified Governmental System for Prevention and Response to Emergency Situations (in Russian). Available online at: http://www.g20gmep.org/wp-content/uploads/Appendix-28-Government-of-the-Russian-Federation-Decree-on-the-Unified-Governmental-System-for-Prevention-and-Response-RU.pdf

[69] UK 2015 Offshore Safety Case Regulations. Regulation 33. Available online at: http://www.hse.gov.uk/offshore/assets/pdfs/safety-case-regs.pdf

[70] UK HSE. The Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations 2015: Guidance on Regulations. Available online at: http://www.hse.gov.uk/pubns/priced/l154.pdf

[71] Canada Oil and Gas Drilling and Production Regulations. Section 1 – Interpretation. Available online at: http://laws-lois.justice.gc.ca/eng/regulations/SOR-2009-315/

[72] UK HSE. A Guide to the Offshore Safety Case Installations (Offshore Safety Directive) (Safety Case, etc.) Regulations 2015. Available online at: http://www.hse.gov.uk/offshore/guide-scr2015-l154.pdf

[73] UK HSE. A Guide to the Offshore Safety Case Installations (Offshore Safety Directive) (Safety Case, etc.) Regulations 2015. Available online at: http://www.hse.gov.uk/offshore/guide-scr2015-l154.pdf

[74] Canada Oil and Gas Drilling and Production Regulations. Article 46 – Well Completion. Available online at: http://laws-lois.justice.gc.ca/eng/regulations/SOR-2009-315/

[75] A Guide to Hydrocarbon Licences in Denmark: Exploration and Drilling Activities. Page. Available online at: http://www.ens.dk/sites/ens.dk/files/undergrund-forsyning/olie-gas/koncessioner/guide-oliegas-koncessioner/GuideToHC.pdf

[76] National Hydrocarbons Commission Regulation 12.001/10. Entire regulation available online (in Spanish) at: http://www.cnh.gob.mx/_docs/ResolucionCNH12_001_10.pdf

[77] Mining Regulation of the Netherlands available online at: http://www.nlog.nl/resources/Legislation/MBREnglishAug%2009.pdf

[78] Norwegian Facilities Regulations. Available online at: http://www.psa.no/getfile.php/Regelverket/Innretningsforskriften_e.pdf

[79] United Kingdom. 2015 Offshore Safety Case Regulations. Available online at: http://www.hse.gov.uk/offshore/assets/pdfs/safety-case-regs.pdf

[80] U.S. Federal Code of Regulations Title 30. Regulation available online at: http://www.ecfr.gov/cgi-bin/text-idx?SID=a1bb933e15dd1521ab1af7fab36cac45&node=pt30.2.250&rgn=div5#sp30.2.250.c

[81] U.S. Federal Code of Regulations Title 30. Regulation available online at: http://www.ecfr.gov/cgi-bin/text-idx?SID=a1bb933e15dd1521ab1af7fab36cac45&node=pt30.2.250&rgn=div5#sp30.2.250.c

[82] National Hydrocarbons Commission Regulation 12.001/10. Entire regulation available online (in Spanish) at: http://www.cnh.gob.mx/_docs/ResolucionCNH12_001_10.pdf

[83] Mining Regulation of the Netherlands available online at: http://www.nlog.nl/resources/Legislation/MBREnglishAug%2009.pdf

[84] New Zealand Health and Safety in Employment (Petroleum Exploration and Extraction) Regulations 2013. Available online at: http://www.legislation.govt.nz/regulation/public/2013/0208/15.0/DLM5203558.html

[85] NORSOK Standard D-010. "Well Integrity in drilling and well operations." Available online at: http://www.govmin.gl/images/stories/petroleum/NORSOK_D010.pdf

[86] Norwegian Activities Regulations. Available online at: http://www.psa.no/getfile.php/Regelverket/Aktivitetsforskriften_e.pdf

[87] Norwegian Facilities Regulations. Available online at: http://www.psa.no/getfile.php/Regelverket/Innretningsforskriften_e.pdf

[88] Norwegian Management Regulations. Available online at: http://www.psa.no/getfile.php/Regelverket/Styringsforskriften_e.pdf

[89] Norwegian Facilities Regulations. Available online at: http://www.psa.no/getfile.php/Regelverket/Innretningsforskriften_e.pdf

[90] UK Health and Safety Executive Well Construction Standards. Available online at: http://www.hse.gov.uk/foi/internalops/hid_circs/technical_general/spc_tech_gen_42.htm#Cement

[91] United Kingdom Health and Safety Executive website. "Verification that safety critical elements are 'suitable' at the commencement of a verification scheme" Accessed at: http://www.hse.gov.uk/foi/internalops/hid_circs/enforcement/spcenf174.htm

[92] U.S. Federal Code of Regulations Title 30. Regulation available online at: http://www.ecfr.gov/cgi-bin/text-idx?SID=a1bb933e15dd1521ab1af7fab36cac45&node=pt30.2.250&rgn=div5#sp30.2.250.c

[93] U.S. Federal Code of Regulations Title 30. Regulation available online at: http://www.ecfr.gov/cgi-bin/text-idx?SID=a1bb933e15dd1521ab1af7fab36cac45&node=pt30.2.250&rgn=div5#sp30.2.250.c

[94] National Hydrocarbons Commission Regulation 12.001/10. Entire regulation available online (in Spanish) at: http://www.cnh.gob.mx/_docs/ResolucionCNH12_001_10.pdf

[95] U.S. Federal Code of Regulations Title 30. Regulation available online at: http://www.ecfr.gov/cgi-bin/text-idx?SID=a1bb933e15dd1521ab1af7fab36cac45&node=pt30.2.250&rgn=div5#sp30.2.250.c

[96] U.S. Federal Code of Regulations Title 30. Regulation available online at: http://www.ecfr.gov/cgi-bin/text-idx?SID=a1bb933e15dd1521ab1af7fab36cac45&node=pt30.2.250&rgn=div5#sp30.2.250.c

[97] U.S. Federal Code of Regulations Title 30. Regulation available online at: http://www.ecfr.gov/cgi-bin/text-idx?SID=a1bb933e15dd1521ab1af7fab36cac45&node=pt30.2.250&rgn=div5#sp30.2.250.c

[98] "Правила безопасности в нефтяной и газовой промышленности", утвержденные приказом Ростехнадзора от 12.01.2015 № 1 (зарегистрирован в Минюсте России 20.02.2015, рег.№ 36191)

[99] Section 65. Norwegian Framework Regulations. Available online at: http://www.psa.no/framework-hse/category403.html

[100] NOPSEMA webpage “Inspections.” Accessed at: http://nopsema.gov.au/safety/inspections/

[101] Working Environmental Authority website. “Inspection of the enterprises.” Accessed at: http://engelsk.arbejdstilsynet.dk/en/Inspection.aspx

[102] Working Environmental Authority website. “Inspection of the enterprises.” Accessed at: http://engelsk.arbejdstilsynet.dk/en/Inspection.aspx

[103] Act Number 13. “On Prospecting, Exploration and Production of Hydrocarbons.” Article 24a. Available online at: http://www.nea.is/media/olia/Act-No-13-2001-14102014.pdf

[104] Regulation 884: “On Prospecting, Exploration and Production of Hydrocarbons.” Article 58. Available online at: http://www.nea.is/media/olia/Regulation-884-2011-03102011.pdf

[105] Act Number 13. “On Prospecting, Exploration and Production of Hydrocarbons.” Article 24b. Available online at: http://www.nea.is/media/olia/Act-No-13-2001-14102014.pdf

[106] State Supervision of Mines 2007 Annual Report. Available online at: https://www.google.com/search?q=Annual+Report+2007+State+Supervision+of+Mines&sourceid=ie7&rls=com.microsoft:en-us:IE-Address&ie=&oe=&gws_rd=ssl

[107] State Supervision of Mines 2007 Annual Report. Available online at: https://www.google.com/search?q=Annual+Report+2007+State+Supervision+of+Mines&sourceid=ie7&rls=com.microsoft:en-us:IE-Address&ie=&oe=&gws_rd=ssl

[108] Mining Act of the Netherlands. Available online at: http://www.nlog.nl/resources/Legislation/Engelse%20vertaling%20Mijnbouwwet1.pdf

[109] Mining Act of the Netherlands. Available online at: http://www.nlog.nl/resources/Legislation/Engelse%20vertaling%20Mijnbouwwet1.pdf

[110] New Zealand Health and Safety in Employment (Petroleum Exploration and Extraction) Regulations 2013. Available online at: http://www.legislation.govt.nz/regulation/public/2013/0208/15.0/DLM5203558.html

[111] Petroleum Safety Authority website. "Responding to regulatory breaches." Accessed at: http://www.psa.no/responding-to-regulatory-breaches/category946.html

[112] UK HSE description of Key Programmes accessed at: http://www.hse.gov.uk/offshore/programmereports.htm

[113] Ocean Energy Safety Advisory Committee, October 15, 2012
Available online at:
http://www.bsee.gov/uploadedFiles/BSEE/About_BSEE/Public_Engagement/Ocean_Energy_Safety_Advisory_Committee/OESC%20Recommendations%20August%202012%20Meeting%20Chairman%20Letter%20to%20BSEE%20101512.pdf

[114] Environmental Regulation at the Frontier: Government Oversight of Offshore Oil Drilling North of Alaska. Available online at:
http://elawreview.org/articles/environmental-regulation-frontier-government-oversight-offshore-oil-drilling-north-alaska/#footnote-5253_342

[115] Ibid [5]

[116] Australian Government Geoscience Australia. Petroleum geology inventory of Australia's offshore frontier basins. 2014. Available online at:
http://www.ga.gov.au/metadata-gateway/metadata/record/gcat_f2a70844-510e-7161-e044-00144fdd4fa6/Petroleum+geology+inventory+of+Australia%27s+offshore+frontier+basins

[117] USGS. World Petroleum Assessment homepage. Accessed at:
http://energy.usgs.gov/OilGas/AssessmentsData/WorldPetroleumAssessment.aspx

[118] OSPAR Commission. "Assessment of impacts of offshore oil and gas activities in the North-East Atlantic." Available online at: http://qsr2010.ospar.org/media/assessments/p00453_OA3-BA5_ASSESSMENT.pdf
[119] EIA Laws. Available online at:
http://eialaws.elaw.org/eialaw/saudi-arabia

[120] Norwegian Ministry of the Environment: Environmental Impact Assessment. Available online at:
http://www.regjeringen.no/upload/kilde/md/bro/2003/0001/pdfv/182783-t-1428_e.pdf

[121] NOPSEMA Interim Guidance. "Management of Offshore Well Operations Plans." Accessed at:
http://www.nopsema.gov.au/assets/Guidelines/N-04600-GL0936-Management-of-Offshore-Well-Operations-Plans-Interim-Guideline.pdf

[122] A Guide to Hydrocarbon Licences in Denmark: Exploration and Drilling Activities. Page. Available online at:
http://www.ens.dk/sites/ens.dk/files/undergrund-forsyning/olie-gas/koncessioner/guide-oliegas-koncessioner/GuideToHC.pdf

[123] A Guide to Hydrocarbon Licences in Denmark: Exploration and Drilling Activities. Page. Available online at: http://www.ens.dk/sites/ens.dk/files/undergrund-forsyning/olie-gas/koncessioner/guide-oliegas-koncessioner/GuideToHC.pdf

[124] Greenland Bureau of Minerals and Petroleum Drilling Guidelines. Page 7. Available online at: http://www.govmin.gl/images/stories/petroleum/110502_Drilling_Guidelines.pdf

[125] Greenland Bureau of Minerals and Petroleum Drilling Guidelines. Page 8. Available online at: http://www.govmin.gl/images/stories/petroleum/110502_Drilling_Guidelines.pdf

[126] National Hydrocarbons Commission Regulation 12.001/10. Entire regulation available online (in Spanish) at: http://www.cnh.gob.mx/_docs/ResolucionCNH12_001_10.pdf

[127] National Hydrocarbons Commission Regulation 12.001/10. Entire regulation available online (in Spanish) at: http://www.cnh.gob.mx/_docs/ResolucionCNH12_001_10.pdf

[128] Mining Regulation of the Netherlands. Entire Regulation available online at: http://www.nlog.nl/resources/Legislation/MBREnglishAug%2009.pdf

[129] New Zealand Health and Safety in Employment (Petroleum Exploration and Extraction) Regulations 2013. Available online at: http://www.legislation.govt.nz/regulation/public/2013/0208/15.0/DLM5203558.html

[130] Norwegian "Facilities Regulations." Entire regulation available online at: http://www.psa.no/getfile.php/Regelverket/Innretningsforskriften_e.pdf

[131] Norwegian Activities Regulations. Available online at: Norwegian "Facilities Regulations." Entire regulation available online at: http://www.psa.no/getfile.php/Regelverket/Innretningsforskriften_e.pdf

[132] Entire regulation available here (in Russian): http://www.rosteplo.ru/Npb_files/npb_shablon.php?id=844

[133] U.S. Federal Code of Regulations Title 30. Regulation available online at: http://www.ecfr.gov/cgi-bin/text-idx?SID=a1bb933e15dd1521ab1af7fab36cac45&node=pt30.2.250&rgn=div5#sp30.2.250.c

[134] Mining Regulation of the Netherlands. Entire Regulation available online at: http://www.nlog.nl/resources/Legislation/MBREnglishAug%2009.pdf

[135] Mining Regulation of the Netherlands. Entire Regulation available online at: http://www.nlog.nl/resources/Legislation/MBREnglishAug%2009.pdf

[136] Norwegian "Facilities Regulations." Entire regulation available online at: http://www.psa.no/getfile.php/Regelverket/Innretningsforskriften_e.pdf