Draft

Report

Health Safety and Environmental Management Systems for Offshore Arctic Oil and Gas Operations and [Recommended] Guidance

Comment [CL1]: NOAA: Consider reviewing the recommendations to DOI/BSEE from the Offshore Energy Safety Advisory Committee. Many of the reports listed in this document and compared several international systems (SEMS, Safety Case) and performance vs. prescriptive standards/regs and came up with some high level recommendations (http://www.bsee.gov/About-BSEE/Public-Engagement/OESC/Index.aspx). It will be interesting if international consensus can be achieved even in the arctic.

Also consider reviewing/incorporating the work of the Center for Offshore Safety (http://www.centerforoffshoresafety.org/)

Outline of Contents

Executive Summary

Terms and Acronyms Used

AMAP:	Arctic Monitoring and Assessment Program working group of the Arctic Council.
AMSA:	Arctic Marine Shipping Assessment, 2009.
API:	American Petroleum Institute
AOGCC:	Alaska Oil and gas Conservation Commission.
AOOGG:	Arctic Offshore Oil and Gas Guidelines, 2009. PAME
AOR:	Arctic Ocean Review, Phase I (2011) and Phase II (2013), PAME
BMP:	Bureau of Minerals and Petroleum, Greenland.
BSEE:	Bureau of Safety and Environmental Enforcement of the United States Department of the Interior.
DnV:	Det Norsk Veritas
EPPR:	Emergency Prevention, Preparedness, and Response working group of the Arctic Council.
EUOAF:	European Union Offshore Authorities Forum
GMEP	G20 Global Marine Environment Protection Working Group
HSE:	Health, Safety and Environment
IADC:	International Association of Drilling Contractors
ICRARD	International Committee on Regulatory Research and Development
IRF:	International Regulators Forum
ISO:	International Organization for Standardization
NEB:	National Energy Board of Canada
NORSOK:	Norwegian Industry Standards.
NSOAF:	North Sea Offshore Authorities Forum
OGA:	AMAP Assessment 2007: Oil and Gas Activities in the Arctic: Effects and Potential Effects, 2010.
OGP:	International Association of Oil and Gas Producers
OSPAR	Oslo-Paris Convention for Protecting the Marine Environment of the North-East Atlantic
OSPR Agreement:	Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic, 2013.
PAME:	Protection of the Arctic Marine Environment working group of the Arctic Council
RBLC:	Risk Based Life Cycle regulatory approach
RP3:	Recommended Practices for Arctic Oil Spill Prevention, 2013. EPPR
RP:	Recommended Practice
SAR Agreement:	Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic, 2011.
SEMS:	Safety and Environmental Management System.
SINTEF:	An independent research organization in Scandinavia.
SMS:	Safety Management System.
TC67 SC8	ISO Technical Committee 67 (Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries), Subcommittee 8 (Arctic Operations).

Etc.

1 Introduction

The information and the guidance recommended in this report are meant to supplement and enhance recommendations in the Arctic Council 2009 *Arctic Offshore Oil and Gas Guidelines* (AOOGG) (PAME 2009a) and more broadly, recommendations of the report on *Recommended Practices for Arctic Oil Spill Prevention* (RP3) (EPPR 2013a), the Arctic Monitoring and Assessment Program (AMAP) *Assessment 2007: Oil and Gas Activities in the Arctic—Effects and Potential Effects* (OGA) (AMAP, 2010) and several other reports and guidelines of the Arctic Council that taken together offer a more comprehensive roadmap to safer offshore operations in the Arctic (see Section 2 Existing Guidance).

Safe offshore oil and gas operations are essential for protecting the health of workers and local communities, as well as the marine environment from pollution. Major offshore oil and gas systems failure accidents often lead to human casualties, fires and explosions, sinkings, and environmental disasters. In the wake of the 19~~9~~88 Piper Alpha disaster in the North Sea, the investigative report identified failure of existing management systems as the fundamental cause of the disaster that killed 167 people. This incident transformed the offshore regulatory process world-wide. Similarly, investigative reports on recent blowouts such as those that occurred in the Montara well in the Timor sea northwest of Australia and the Macondo well in the Gulf of Mexico, have identified the human factor--failure of Health, Safety and Environmental (HSE) Management Systems and lack of "safety culture"--as a root cause of the specific problems that led to these blowouts. Correspondingly, these more recent incidents are also transforming how regulators are overseeing offshore operations.

It is well accepted that conditions in the Arctic are extremely challenging for oil and gas operations. If an incident such as what happened with the Deepwater Horizon/Macondo well were to occur in the Arctic, the outcome could be much worse than what are already devastating outcomes for the people and ecosystems in the Gulf of Mexico and beyond.

In the Arctic,

- casualties could be higher because of more difficult evacuation, emergency response and rescue conditions;
- more oil could be spilled because it may take longer to contain and cap the wellhead;
- less oil would be cleaned up or recovered because of a lack of supporting vessels and infrastructure and ice interference with removal techniques and equipment;
- more environmental damage could be done because of the fragile and sensitive nature of the environment and persistence of oil in cold temperatures.
- it would also result in serious socioeconomic and cultural consequences for local communities that depend on the Arctic ocean for their subsistence.

There has been growing interest in Arctic offshore petroleum resources and anticipation of increased activities in the region. There has also been a growing concern about the potential effects an increase in those activities will have on the Arctic marine environment and the way of life of indigenous people and local communities. The Protection of the Arctic Marine Environment (PAME) working group mandate includes providing policy guidance to Arctic states on how to protect the Arctic marine environment in relation to current and emerging

Comment [D2]: BSEE: Sections 1& 2 of the Report provide background information introducing the importance of management systems and their key role in protecting the sensitive Arctic environment. The project is also framed in the context of the PAME working group mandate. Two goals for the project are clearly stated: to provide guidance on HSE Management Systems for Arctic offshore petroleum operations and to serve as an update to the AOOGG. These two goals should provide the direction for the rest of the report.

issues. It is within that context that this report was developed -- in order to provide guidance on HSE management systems for Arctic offshore petroleum operations, and as an update to the AOOGG.

After the Deepwater Horizon/Macondo well incident, there have been many investigative reports and hearings generating urgent recommendations for improvement in the offshore oil and gas industry to avoid any future major accidents. It has been almost 4 years since the Macondo well blowout, this report should keep fresh in the minds of Arctic regulators the root causes for this "pinnacle event"—which were failure of safety management systems and lack of a positive safety culture. Much has happened to improve safety and environmental performance in offshore operations since April 20, 2010. Both industry and regulators have started working to implement many of these recommendations.

However, the process of improvement is never finished and industry and regulators must continually strive to avoid the complacency that erodes safety culture, and undermines safety and environmental protection. The findings and guidance of this report are relevant and should be used by, or as a reminder to, Arctic states to strengthen and continually improve their oversight of Arctic offshore operations for protection of the marine environment.

While HSE Management Systems and Safety Culture are clearly in the domain of industry and must be defined, implemented, measured, improved, and controlled by the operator, governments and regulators have a key role in influencing improved performance and positive safety culture. The findings and guidance and workshop recommendations in this report identify some of areas that are under the regulators control and the things governments can do to improve HSE management systems and safety culture in the industry.

2 Project Background

Comment [D3]: BSEE: Sections 1& 2 of the Report provide background information introducing the importance of management systems and their key role in protecting the sensitive Arctic environment. The project is also framed in the context of the PAME working group mandate. Two goals for the project are clearly stated: to provide guidance on HSE Management Systems for Arctic offshore petroleum operations and to serve as an update to the AOOGG. These two goals should provide the direction for the rest of the report.

In the aftermath of the Deepwater Horizon/Macondo well accident in spring and summer of 2010, the Arctic Council began to reevaluate the need for further guidance on Arctic offshore oil and gas activities. [The Arctic Offshore Oil and Gas Guidelines had been issued just a little less than a year before.]

In evaluating the findings and recommendations of the OGA and the guidance in the AOOGG in addition to other Arctic Council documents, it is clear that the basic guidance is still pertinent and valid. However, this review found that there is a need for a more in-depth look at the management systems being employed in Arctic operations and a need for PAME to emphasize Arctic aspects of HSE[1] Management Systems and best operating practices beyond what was published in the AOOGG..

At the February 2011 PAME meeting the working group proposed the project, *HSE Management Systems and Best Operating Practices for Offshore Oil and Gas Drilling Activities* (HSEMS), as

[1] Although the term (Health, Safety and Environmental) HSE Management System is used throughout, it is recognized that some systems deal with different aspects, there may be Safety and Environmental Management Systems (SEMS) and others. HSE is used for convenience but applies to any combination of HSE system components and in the case of this report does not include occupational health or safety.

a follow-up to the AOOGG. The HSEMS Project was then approved by Arctic Ministers at the May 2011 Ministerial meeting in Nuuk, Greenland.

The main components of the HSE Management Systems Project include; conducting a survey and compilation of Arctic States requirements and guidance for HSE management systems and operating practices for offshore oil and gas drilling operations, conduct an Arctic workshop on HSE management systems, consider expanding or supplementing the HSE management systems guidance in AOOGG.

The original scope of the HSEMS project included best practices in addition to HSE Management Systems. However, it was later decided that the issue of Best Practices was subsumed into the Management System to a great extent and use or failure to use best practices is controlled by management systems and safety culture of the operating company. Therefore, this report deals primarily with processes of the management systems rather than best operating practices for complex oil and gas operations as they may apply in the Arctic.

Another reason it was decided to not deal specifically with Best Practices, was that shortly after this project was approved by the Arctic Ministers, they directed the EPPR and other relevant working groups to develop best practices/recommendations for prevention of oil pollution. EPPR subsequently embarked on the Recommended Practices for Prevention of Pollution Project covering this aspect and published the *Recommended Practices for Arctic Oil Spill Prevention*. (EPPR, 2013a)

Although the common reference to HSE (Health, Safety and Environment) for these management systems is used in this report, for practical purposes, it deals only with process, or systems safety, not occupational safety, per se. Also, it does not deal with the "H" or occupational health aspect. Nor does it deal specifically with routine environmental management issues such as waste handling and emissions. These aspects of HSE management are dealt with in the AOOGG (PAME, 2009a) and the OGA (AMAP, 2010).

Box 1: The Human Factor

Best practices may exist but rely on the human element to reduce risk.

- If best practices are not communicated, they will not be known or understood, and not used
- If best practices are not documented, it won't be known what was used, or if they were used
- If people are not trained in the use of best practices, they cannot use them or employ them
- Best practices will not be used if a decision is made not to use them

And finally, the original project proposal was for "drilling activities" only, and it was decided that this should not be restricted to only drilling activities because the operator's management systems cover a wider range of operations.

3 [Review of] Existing Arctic Council Guidance

In recognition of the importance of HSE Management Systems to the safety of operations and protection of the marine environment, a tremendous amount of literature, research and guidance documents exist for developing, maintaining and improving HSE Management Systems for oil and gas and other industries. Of these, many have been produced by the Arctic Council working groups in order to provide guidance specifically on operations in the Arctic. A select biography of relevant HSE documents is included in Appendix 4 of this report. As a component of HSEMS project a review of the existing guidance was completed and a few reports were found to have specific relevance to the subject matter covered in this report. These are:

- OGA (AMAP, 2010);
- The *Arctic Marine Shipping Assessment* (PAME, 2009b)
- *Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic* (SAR Agreement) (Arctic Council, 2011),
- *Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic* (OSPR Agreement) (Arctic Council, 2013),
- *Recommended Practices for Arctic Oil Spill Prevention* (RP3 Report- EPPR, 2013a)
- *Operational Guidelines for Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic* (EPPR, 2013b)

Finally, there are many Arctic Council guideline documents that taken together cover all aspects of offshore oil and gas activities. These include:

- the *Arctic Region Oil Spill Response Resource and Logistic Guide*;
- *Arctic Response Cooperation Guidelines*;
- *Guidelines for Transfer of Refined Oil and Oil Products in Arctic Waters*;
- *A Field Guide to Oil Spill Response in Arctic Waters*;
- *Arctic Shoreline Clean-up Assessment Technique (SCAT) Manual*;
- *Environmental Risk Analysis of Arctic Activities*;
- *Circumpolar Map of Resources at Risk from Oil Spills in the Arctic*; *Arctic Guide for Emergency Prevention, Preparedness and Response*; and the
- *Arctic Offshore Oil and Gas Guidelines (AOOGG).*

The AOOGG, in particular, devotes considerable space to general guidance on important and related HSE Management Systems issues in Section 5, Safety and Environmental Management (pp 25-29); Section 6 Operating Practices (pp 31-41); Section 7 Emergencies (pp 43-47), ANNEX B - Definition of Practices and Techniques (pp 79-80), ANNEX F - Environmental Risk Analysis Flow Diagram (p 88), and ANNEX G - Company Safety, Environmental Policies and Objective (p 89) (See Appendix 2). The RP3 Report also identified HSE Management Systems and Safety Culture as a primary area of concern for prevention of pollution.

Comment [D4]: BSEE: Section 3, "*Existing Arctic Council Guidance*", provides a list of documents that have specific relevance to topics covered by this project. However, no further information or analysis of the positions and recommendations reflected in these documents is provided. We recommend that a short abstract highlighting the HSEMS issues, guidance, or recommendations be included for each document identified as being relevant to the project. In addition, the project team should provide a summary from their literature review highlighting common themes, areas identified for improvement in HSEMS programs, areas where additional research is necessary or where the guidance offered conflicts with another document.

4 Investigations of the Deepwater Horizon/Macondo Well Accident and Regulatory Reviews

On the 20 of April 2010 a massive explosion and fire occurred on the Deepwater Horizon mobile drilling unit on the Macondo field in the Gulf of Mexico. Eleven people were killed and oil began to gush uncontrolled into the ocean. More than four million barrels of oil would be spilled by the time the blowout was halted 87 days later, making it the largest oil spill in U.S history to date. The costs from this one industrial accident are not yet fully counted, but US sources have estimated economic losses totaling in the tens of billions of dollars.[2]

In the aftermath of the Deepwater Horizon/Macondo well accident the offshore oil and gas industry came under increased scrutiny. A large number of investigations were launched by government appointed bodies and regulators in order to understand exactly what had gone wrong and how to prevent it from happening again. A list of these investigations findings and reports can be found in Appendix 3 of this report.

While most of these investigative findings and recommendations are specifically aimed at the Deepwater Horizon/Macondo well incident, the findings clearly show the root causes of the accident are common to all systems failure accidents and indicate problems with safety culture and management systems in the offshore petroleum industry in particular.

Of the many investigations into the Deepwater Horizon/Macondo well accident, PAME considered five of them for the Arctic HSEMS project. These included:

1. *Macondo Well–Deepwater Horizon Blowout: Lessons for Improving Offshore Drilling Safety Offshore.* This report was released by the Committee for Analysis of Causes of the Deepwater Horizon Explosion, Fire, and Oil Spill to Identify Measures to Prevent Similar Accidents in the Future, National Academy of Engineering in December 2011.

2. *Deep Water: The Gulf Oil Disaster and the Future of Offshore Drilling, Report to the President* [3], This report was commissioned by the President of the United States after the Deepwater Horizon/Macondo well accident and was released by the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling[4] in January 2011. It contains a forward looking section on the challenges of working in Frontier areas, including the Arctic.

3. *State of Alaska Oil and Gas Conservation Commission Hearings on Drilling Safety September 15-16, 2011* This report was based on the State of Alaska hearings on Drilling Safety held September 15-16, 2011.

[2] http://www.oilspillcommission.gov/sites/default/files/documents/FinalReportIntro.pdf
[3] National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling Report to the President www.oilspillcommission.gov
[4] National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling Report to the President www.oilspillcommission.gov

Comment [D5]: BSEE: Section 4 uses the Deepwater Horizon as a basis for justifying the importance of HSEMS and Safety Culture. This section summarizes the lessons learned from Deepwater Horizon but does not provide any new information related to recommended changes to a HSEMS or direct insights into an arctic application. We recommend that this discussion be linked to the later discussion on HSEMS, rather than being presented as a standalone section talking about DeepWater Horizon. The discussion on the common issues identified from the incident investigations are very informative and relevant, however it leaves the reader wondering why this information was included in this report about HSEMS for an Arctic application. Therefore, we suggest that the report uses the HSEMS discussions as the framework and use some of these key /common issues from Deepwater Horzon to support the project team's assessment or recommendations for HSEMS/Safety Cultures for the Arctic.

4. *Arctic Offshore Drilling Review*, National Energy Board of Canada. In response to the disaster in the Gulf of Mexico, the NEB initiated a review of the safety and environmental requirements for offshore drilling in Canadian Arctic waters.

5. *The Deepwater Horizon accident—assessment and recommendations for the Norwegian Petroleum Industry*. The Petroleum Safety Authority of Norway (PSA) commissioned a report, this report to look at improvement opportunities from lessons learned after the Deepwater Horizon/Macondo well accident.

On the invitation of PAME representatives from agencies responsible for these investigations presented on these five investigations as part of the HSE Management Systems Workshop held in Keflavik, Iceland, June 10-12, 2012 and the Safety Culture Workshop held in Halifax, Canada, September 16, 2012.

The overall findings and lessons learned that were communicated to PAME through those presentations is of particular relevance to the HSEMS project. A full summary of those presentations is included in Appendix 1 of this report.

Additional information was drawn from published reports including:

1. Petroleum Safety Authority Report--The Deepwater Horizon accident—assessment and recommendations for the Norwegian Petroleum Industry (PSA, 2011)[5]
2. Department of Interior Assessment of Shell 2012 Arctic Drilling Program, March 8, 2013 (DOI, 2013)

In considering the findings and recommendations coming out of these reports in this section, there were many common key issues and recommendations that are of valuable when looking at HSEMS in the Arctic context.

4.1 Key/Common Issues Identified

4.1.1 Lack of a Safety Culture

Overall all the reports found that **safety culture was lacking throughout the offshore oil and gas industry and the lack of a shared safety culture is a common root cause in most industrial accidents.** In the case of the Deeepwater Horizon/Macondo Well in particular, there a was a lack of fail-safe design, testing, training, and operating practices aboard the rig and no overall systems approach to safety, evident in the multiple flawed decisions that led to the blowout. The decisions made by the companies involved revealed systemic failures in risk management.

Key Considerations:

[5] The Deepwater Horizon accident—assessment and recommendations of the Norwegian Petroleum Industry http://www.ptil.no/getfile.php/PDF/DwH_PSA_summary.pdf

The oil and gas industry must adopt a "culture of safety" as a collective responsibility with a focused commitment to continuous improvement and zero failure rate, and it must set up mechanisms to implement.

Safety culture is not an optional extra. It must be demanded, guided, measured, verified, and improved. An effective safety culture is fostered through consistent training, adherence to principles of human factors, system safety and continued measurement through leading indicators.

4.1.2 Unclear Accountability

It was found that in the case of the Deeepwater Horizon/Macondo Well accident there were multiple non-integrated and flawed decisions made with no one looking at totality of the operation or the risk. **Unclear accountability led to failure by both the operator and contractors**. There was a complex managerial structure for operations at the Macondo Well which led to a lack of accountability. Operators and their contractors have to have very clear lines of responsibility and accountability for an effective systems approach to safety.

Key Considerations:
Operating companies should be held responsible and accountable for well design, well construction, and suitability of rig and safety equipment and must maintain strong, direct management and oversight of their contractors. The drilling contractor should be held responsible and accountable for the operation and safety of the offshore equipment.

Improvement is needed within corporate and industry-wide systems for reporting safety-related incidents; near-miss reporting should be made public. Providing protection for "whistleblowers" for safety problems is important.

Comment [CL6]: NOAA: Suggest adoption of something similar to FAA/NASA near-miss reporting

Few regulators do enough to influence and oversee contractor behavior. It should be required that operators have a dedicated, accountable officer responsible for the safety management system, including preparing annual reports on its performance.

Comment [CL7]: NOAA: These will only help if the metrics are standard and real and if there is adequate regulator time to review the reports

4.1.3 Lack of Knowledge

Offshore oil and gas operations are highly complex and technical in nature. In the case of the Deepwater Horizon/Madondo well accident, **there were a series of identifiable mistakes made by the companies involved which led to the cause of the blowout**. Issues were also identified with the oversight of the regulator at the time which were questionable and which have led to a push for improved technology and training both in the industry and for regulators.

Key Considerations:
There is a need to greatly expand R&D to improve overall safety of offshore drilling. There is also a need to significantly expand the formal education and training of industry and regulatory personnel engaged in offshore drilling to support proper implementation of system safety. In the case of proposed Arctic offshore operations, requiring Arctic-specific Blowout Preventer training of operators, contractors and inspectors should be considered.

Comment [CL8]: NOAA: While it is obviously a good idea to be proficient and current on the operation of any safety device employed, it is not clear that this requirement would have prevented DWH had it been in place. Operation of the blowout preventer was not the problem; engineering of the device and meaningful consideration of (and/or oversight to address) the consequences of its failure were more of an issue.

4.1.4 Regulatory Clarity, Consistency and Oversight

Violations of regulations by the operator, soft penalties, lack of inspections by the regulator combined with, poor monitoring of the operators performance, greatly increases the risk for a major accident. In regard to offshore operations performance monitoring is critical for identifying problem trends. Monitoring can encompass many things such as incidents, near misses, system failures, well integrity issues, kicks, gas releases and can include workers surveys. An international database on incidents with complete, accurate and verifiable data is needed, as is the development of international standards. A key issue is not just data, but *how the data is analyzed and used*.

In the case of the Deepwater Horizon/Macondo Well accident, complex regulations and regulatory overlaps and gaps made understanding compliance and accountability difficult.

Key Considerations:
Continued strong coordination across government agencies is essential in the permitting and oversight process. The responsibility of regulating should be consolidated into a competent agency or body. It is important to designate a single agency with responsibility for ensuring an integrated approach for system safety for all offshore drilling activities.

Regulators need to conduct inspections, enforce regulations, and monitor performance. They should consider implementing a hybrid regulatory system which integrates a number of prescriptive elements into a pro-active, goal-oriented risk management system.

Keep the regulator focused on regulating. Non-regulatory responsibilities, placed on the agency that enforces the law, reduces the ability of the regulators to do their jobs and it increases safety concerns. Non-regulatory responsibilities should be assigned to other agencies or bodies. The regulator needs to make sure it regulates and not operates.
Industry and government need to continue to develop and refine standards and practices that are specific to the unique and challenging conditions associated with offshore oil and gas exploration. An international database and international standards should be developed.

4.1.5 Challenging Operating Conditions

The loss of well control and subsequent systems failure that occurred with the Deepwater Horizon/Macondo Well accident is not just a problem restricted to deepwater type of operations. It can happen in any frontier area where operations are complicated and complex, such as the Arctic offshore. Operating conditions have proven to be challenging in the Gulf of Mexico, the Arctic offshore would include an additional range of factors that would significantly increase the level of difficulty. The Arctic is cold and dark for what can be significantly longer periods throughout the day seasonally, it is extremely remote, it has extreme weather, inadequate nautical charting, and poor communication and onshore infrastructure. There is also underdeveloped technology for drilling and spill response that is appropriate to the conditions.

Comment [CL9]: NOAA: By whom? Enforced how? Who administers?

Would suggest mandatory safety stand-downs for incidents meeting some threshold of potential severity. The amount of time of the stand down and the closeness of inspection or reporting during the stand down would ramp up as a given operator or contractor accumulated incidents. This would discourage habitual offenders and would impact operators in proportion to their operations.

Comment [CL10]: NOAA: Agree that both regulator and operator should know who is responsible for what, but don't know that a single agency can cover all bases – e.g., will BSEE have to inspect the lifeboats on an offshore rig?

Comment [D11]: Not True Harsh environment rigs already exist

The Deepwater Horizon/Macondo Well accident demonstrates the need for improved risk management and processes with built-in safety margins that enable the operator to handle human and technical error, operational non-conformities, unexpected conditions, the pressure of events, etc.

Key Considerations:
Reliable weather and ice forecasting play a significant role in ensuring safe operations offshore. Operators must understand and plan for the variability and challenges of off-shore conditions. In the Arctic a company should be able to demonstrate how they would meet or exceed the intended outcome of a single season relief well policy, i.e., to kill an out-of-control well in the same season in order to minimize harmful impacts on the environment. [i]

It should be required that operators are able to ensure timely access to demonstrated capping and containment capabilities. A reviewed and approved blowout contingency plan that is appropriate for the location and well conditions should be required for all offshore operations, especially in the Arctic context.

All phases of an offshore Arctic program – including preparations, drilling, maritime and emergency response operations – should be integrated and subject to strong operator management and government oversight. Arctic offshore operations must be well-planned, fully ready and have clear objectives in advance of the drilling season.

Industry is responsible for maintaining and monitoring well barriers for preventing uncontrolled release of hydrocarbons. Industry must do a better job ensuring margins of safety are built in to the design and modification of wells and are not exceeded. At lease two independent physical barriers should be maintained.

[4.1.6 Leading Indicators

4.1.7 Training and Competence

4.1.8 International Standards]
Possible additions]

5 HSE Management Systems and Safety Culture Workshops

As part of the HSEMS project PAME hosted two Arctic oil and gas workshops. The first workshop was on Health Safety and Environment Management Systems (HSEMS) held in Keflavik, Iceland, June 10-12, 2012. The second workshop was on Safety Culture and was held in Halifax, Canada, September 16, 2012. Both of these workshops convened international experts from governments, industries, and academia, indigenous peoples organizations, and other Arctic stakeholders for full one-day presentations and discussions.

Box 2 June 10, 2012 HSEMS Workshop Presentations

Deepwater Horizon Investigations, Reviews, Assessments – HSE:

- ***Deepwater Horizon Investigation National Academy of Engineering:*** **Donald Winter**, Professor of Engineering Practice, University of Michigan and chair of the National Academy of Engineering Committee for Analysis of Causes of the Deepwater Horizon Explosion, Fire, and Oil Spill to Identify Measures to Prevent Similar Accidents in the Future.
- ***Deepwater Horizon Assessment and Recommendations:*** **Magne Ognedal**, Director General, Petroleum Safety Authority, Norway.
- ***State of Alaska Hearings on Safety and Environmental regulation:*** **Catherine Foerster**, Commissioner, Alaska Oil and Gas Conservation Commission.
- ***Arctic Offshore Drilling Review:*** **Céline Sirois**, Technical Leader, Environment, National Energy Board of Canada.

Presentations by selected regulators on their HSE systems

- ***U.S. Safety and Environmental Management Systems—SEMS:*** **Joseph Levine**, Branch Chief, Emerging Technologies, Bureau of Safety and Environmental Enforcement.
- ***Norwegian HSE Management Systems***: **Magne Ognedal**, Director General, Petroleum Safety Authority, Norway.
- ***Greenland's HSE Management Systems:*** **Jens Hesseldahl**, Greenland Bureau of Minerals and Petroleum
- ***Canada's Arctic offshore HSE Management Systems:*** **Céline Sirois,** Technical Leader, Environment, National Energy Board of Canada.
- ***Arctic Council Offshore Oil and Gas Guidelines:*** **Dennis Thurston**, Bureau of Ocean Energy Management, USA

This section highlights some of the findings and recommendations of the two offshore oil and gas workshops--the full summary of these findings and recommendations is found in the Appendix 1. The full workshop reports with all presentations and discussions are published separately by PAME (PAME, 2013a[6] and 2013b[7]).

The HSEMS Workshop discussed investigations of the Deepwater Horizon/Macondo accident and lessons learned that relate to Arctic operations, HSE management systems requirements of selected Arctic countries, results of recent changes in Arctic regulatory regimes, and in an open session, various HSE elements that may need more focus in an Arctic context. One issue, safety culture, rose to the importance of warranting a separate workshop.

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Comment [D12]: BSEE: In 2012, PAME hosted two separate workshops on HSEMS and Safety Culture. Section 5 of the report provides a list of direct comments made during the workshop discussions. Although the raw comments are interesting, the key deliverables should be the common or recurring themes and ideas. Appendix 1 (as identified in the outline label 5.4) contains a good summary of the common themes and concepts from the workshops. This summary and discussion should be incorporated into the body of the report and could be used to support any project team recommendations. The information presented, discussed and summarized in Appendix 1 should provide the basis for the report. The lists of specific comments should be moved to the appendix. The blue boxes should also be included in an Appendix.

[6] http://www.pame.is/images/PAME_Ministerial_2013/HSE_Workshop_Report_10-12_June_2012.pdf

[7] http://www.pame.is/images/PAME_Ministerial_2013/Safety_Culture_Workshop_Report_16_Sep_2012.pdf

The Safety Culture Workshop consisted of a group of invited experts from various industries, government bodies, and academia who presented information on the subject of "safety culture" as it applies to the prevention of systems/process failure accidents and pollution incidents.

Three questions were posed to the participants of the two workshops in pre-meeting background documents. They were not meant as a questionnaire and required no answers of the participants, but were meant for provoking thought and steering discussion. From presentations and discussions at the workshops, we provide answers to the three pre-workshop questions.

Box 3 September 16, 2012 Safety Culture Workshop Presentations

Lessons learned from the Deepwater Horizon Accident: what influences safety culture? **Fran Ulmer**, Commissioner of the U.S. Arctic Research Commission and Member of the Presidents Commission on the Deepwater Horizon Oil Spill and Future of Offshore Drilling.

Process and Systems Safety: **Donald Winter**, Professor of Engineering Practice, University of Michigan and chair of the National Academy of Engineering Committee for Analysis of Causes of the Deepwater Horizon Explosion, Fire, and Oil Spill to Identify Measures to Prevent Similar Accidents in the Future.

U.S. Navy's Submarine Safety Culture: **David Duryea**, Rear Admiral, Deputy Director for Undersea Warfare Naval Sea Systems Command.

Safety Culture in the Offshore Oil and Gas Industry-A Shell View: **Dwight Johnston**, Vice President of Safety, Environment, and Sustainable Development for DeepWater, Shell.

Safety Culture and Leadership Improvement—Modern Day Alchemy: **Mark Fleming**, Professor of Psychology, Saint Mary's University, Halifax.

5.1 *What can we learn in the Arctic from the Deepwater Horizon and other offshore drilling accidents?*

- The Deepwater Horizon and other offshore disasters were foreseeable and preventable.
- Recent accidents reveal systemic failures in risk management and poor safety culture in the industry.
- Investigations of major have a tendency to focus on identifying a direct cause, but complex systems rarely repeat a previous accident exactly and usually have complex causality related to unique system technology and/or design.
- Major offshore systems failure accidents can happen anywhere but are more likely in frontier areas where there is ~~a lack~~ less ~~of~~ experience and operations are complex, challenging, and have more uncertainties.
- Lack of or deficient overall systems approach to safety leads to a poor safety culture and systems failure accidents, including low probability-high risk events.
- An integrated systems view and approach to safety of the whole operation must be maintained by the operator.
    - no one was monitoring the margins of safety.
    - no one was looking at the totality of risk.
    - no systems approach to safety.
- The complex structure of the offshore oil and gas industry and the divisions of technical expertise makes it difficult to perform and maintain an integrated assessment of the margins of safety.
- Accountability must be clear.

Comment [D13]: USCG: Operators are currently drilling in harsh environments. Overstatement.

- Contractors, subcontractors, and sub-subcontractors must be an integral part of the systems safety of the overall operations through the operators safety and environmental management system, and be vetted, trained, overseen and held accountable by the operator.
- Appropriate margins of safety (system resilience) need to be developed to deal with uncertainties associated with the construction of a well, in particular exploratory wells, such as geology, weather, well construction materials, and uncertainties in the way people behave when confronted with different situations.
- Improve Barrier Management--There must be at least two approved operating barriers at all times that are monitored and maintained.
- Develop risk analysis processes and tools for the well planning phase (well design and drilling plan).
- Improve Management of Change--Including risk analysis processes and tools for better handling of changes to the drilling plan during the operational phase.
- Do not confuse systems and occupational safety.
- To avoid major systems failure accidents, eliminate tolerance of inadequate systems and resources; normalization of deviation from safety policy; complacency; and conflicting work pressure from the culture.
- Adopt a systematic approach and do not think of Safety Culture as an "Optional Extra."
- Do not deceive yourself and do not believe your own Public Relations
- Have "chronic unease" while operating and regulating

5.2 ***What can we learn in the Arctic oil and gas industry and regulatory community from other industries and activities such as Naval, Aviation and Nuclear?***

- HSE Management Systems failures in Planning elements were factors in many accidents including inadequate or no hazard identification, risk assessments and related controls.
- HSE Management Systems failures in Implementation elements were factors in many accidents including the lack of communications, documentation and document control; operational control; management of change; and lack of adequate training
- HSE Management Systems failures in Corrective Actions & Management Review elements were factors in many accidents including deficient inspections and monitoring; inadequate corrective and preventive actions to address identified deficiencies; poor records management; poor internal audits, and lack of adequate management review.
- The basic structure of industrial safety systems are mostly adequate, but the focus in the petroleum industry is on occupational safety, which does not adequately address major systems failures and low probability-high consequence events.
- Increase accountability by requiring signatures for specification, verifications and approvals (Navy, Aviation).
- Near miss reporting methods (Aviation).
- Risk management techniques and processes (Aviation, Nuclear, Navy).
- Separate Safety and Cost/Schedule responsibilities (Navy, Aviation).
- Contractors must be accountable to, and overseen by the responsible party (Navy, Aviation).
- Target ~~ignorance~~ [unawareness] and ~~arrogance~~ [overconfidence] which also contribute to systems failure accidents (Navy).

Comment [D14]: USCG: Great in theory. At some point an economic decision has to be made that takes into account all factors.

Comment [D15]: USCG: Suggested edits.
NOTE: These were the words used by Admiral Duryea.

- Safety systems may be established but not implemented (multiple sectors).
- Enact laws with "claw back" provisions for corporate senior management, where previous bonuses get pulled back for bad safety or environmental performance (Financial sector).

5.3 *What is the advice regarding Arctic offshore operations that can be given to regulators and policy makers?*

- View the Arctic as an international zone.
- The Arctic is different.
- Require integrated planning for complex Arctic operations such as hazard analysis, integrated risk assessments and analysis, and operational procedures and controls for the all aspects of the operation including well design and drilling plan.
- Demand and verify a positive safety culture for operators in the Arctic.
- Hold the operator responsible and accountable for safety and environmental protection during Arctic operations.
- Continue to develop and improve hybrid regulatory systems integrating a limited number of prescriptive elements into a pro-active, goal-oriented risk management system, which is better suited to the Arctic.
- Strive for continued improvement, in the Arctic operator's performance and in regulatory oversight.
- Consider establishing an independent "Technical Authority" that is separate and independent from the operator and regulator that focuses on the review and approval of any variances from approved or agreed procedures or specifications for Arctic operations.
- Require operators to develop a comprehensive 'safety case' as part of their exploration and production plans for certain high-risk areas including the Arctic.
- Develop more detailed requirements for incident reporting and data concerning offshore incidents and 'near misses' in and outside of the Arctic and make it publicly available.
- Assign individual civil and criminal liability for corporate leaders for certifying their management systems for Arctic operations.
- Publish Arctic Safety Plans, Contingency and Emergency Response Plans and Environmental Protection Plans.
- Require Real-Time Monitoring of critical operations and equipment during Arctic operations.
- Require specialized training and certification for operators, contractors, and regulators in Arctic conditions and equipment.
- Require same season relief well capability in the Arctic.
- Require and ensure availability of capping/containment systems for Arctic operations.

It is clear from the two workshops that investigations of major industrial accidents, including offshore oil and gas disasters, show that they have similar root causes—failure of management systems and poor safety culture. It is also clear that lessons from these industrial accidents can and should be applied to Arctic offshore oil and gas operations.

Comment [D16]: USCG: Why just the Arctic?

Comment [D17]: USCG: Who "certifies" this Independent Third Party?

Comment [D18]: USCG: What happens to the corporate leader when a worker, on the drill floor, misses a tell tale and the well blows out? Perhaps add something that draws on punishing those who sign off on a management system found to be inadequate.

Comment [D19]: USCG: What would this entail?

[5.4 Outline of Finding and Recommendations of the HSE and Safety Culture Workshops in Appendix 1
[This section is bracketed, as the full summary is included in the Appendix 1, but it may be useful to have the outline in the Report itself]

Findings and Recommendations: Investigations of the Deepwater Horizon/Macondo Well Accident and Regulatory Reviews

HSE Management Systems Findings
- *Systems Safety*
  - Low Probability High Risk events
  - Systems (or Process) Safety
  - Balance or Tradeoffs
  - Challenges
  - Process versus Implementation
- *Risk Management*
  - Safety Margin Management
  - Monitoring Risk
  - Additional instrumentation
  - Failure Modes & Effects Analysis
  - The Arctic Offshore
  - Δ Arctic = $\uparrow$ Risk
  - Challenges
- *Guidelines, Standards and Regulations*
  - Common Standards
- *Regulatory Approach*
  - Prescriptive and Performance-based
  - Inspectors Role
  - Risk-Based Regulation
  - Challenges
- *Lessons Learned*
  - Learning and Teaching
  - Challenges
- *Authority and Accountability/Responsibility*
  - Responsibility
  - Affirmative Defense
  - Aviation Industry model
  - U.S. Navy system
  - Nuclear Industry
  - Incentives
- Incentives for Safety Culture
  - Contractors
  - Regulator
  - Challenges
- *Audit and Review*
  - Challenges

Reporting
Challenges
Continuous Improvement
Challenges
Safety Culture
Definitions of Safety Culture
Attributes of a positive Safety Culture
Effective Safety Culture
Indicators and Safety Culture
Audits and Review
Contractors Safety Culture and HSE
Six Dimensions of Safety Culture
Challenges
Partnerships
Openness, Partnership, Cooperation
Challenges
Proprietary Data and Near Miss Reporting
Challenges
Liability
Capping and Containment
Arctic Offshore Oil and Gas Guidelines

HSE Management Systems Recommendations
HSE Management Systems
Managing Risk
Auditing/Review
Real Time Monitoring
Accountability
Qualifications
Liability
Reporting
Safety Culture
Define Safety Culture
Audits, Assessments and Metrics
Incentives for Safety Culture
Incentives and disincentives
People
Information
Regulation
Openness, Partnership, Cooperation
Safety Culture Improvement System
Capping and Containment
Sharing Capping and Containment equipment
Capping or Containment Stack requirements
Relief Wells
Proprietary Data and Near Miss Reporting

International Standards
Develop an international database and international standards]

6 Findings and [Recommended] Guidance of the HSE Management Systems Project

These findings and [recommended] guidance are a supplement to the HSE guidance in the AOOGG and should be read in conjunction with the corresponding sections contained in those guidelines (Appendix 2). The findings and [recommended] guidance are derived from published information, reports, hearings, and most importantly, from the presentations and discussions in the two supporting workshops on HSE Management Systems (PAME, 2013a) and Safety Culture (PAME, 2013b). The AOOGG, RP3 and other Arctic Council documents also cover relevant HSE issues, therefore this report contains only a few major elements that were felt to be in need of extra attention in the Arctic. The scope of the findings and recommendations in the workshop reports and summarized in Appendix 1 are considerably greater than those reported here and should be read for possible ways to further improve performance in the Arctic offshore oil and gas sector.

Comment [D20]: BSEE: Section 6 of the Draft Report represents the findings and guidance derived from the multiple sources, most commonly the Deepwater Horizon Reports and the AOOGG. As currently written, this section is excessive in its description of several HSEMS/Safety Culture concepts and their applicability to oil and gas without adequately relating them to the Arctic, or to any new information or insights from the workshops. This section could be shortened to basically just restate several of the core messages (*e.g.* perscriptive vs. performance based regulations, need for regional coordination) as they relate to the Arctic, rather than restating entire sections of what has already been published in the AOOGG/Deepwater Horizon documents. The restatement of the elements of a generic HSEMS, dilutes the focus of this project.

A summation of the HSEMS elements common to the Arctic State countries, incorporating key learning's from the workshops as well as the few core messages from Deepwater Horizon will more clearly reinforce the importance of HSEMS and Safety Culture implementation and highlight the relevance to Arctic development.

6.1 Findings

Investigations of recent major offshore oil and gas accidents have resulted in many findings and recommendations that are pertinent to complex Arctic offshore operations. The drilling of a deep water oil well such as the one in the Macondo oil field where the Deeepwater Horizon accident occurred is an extremely complicated endeavor involving many interacting systems, processes and complex technology[--in an extreme environment]. The Arctic is also a frontier area, where technology and practices are pushing against the experience envelope. There are many challenges and unknowns in complex offshore Arctic operations. The limited experience in drilling relatively few offshore wells in the Arctic ~~and sparse technical knowhow~~, much of which has been lost over the decades, means to some extent "you learn as you go." This type of situation necessitates constantly evaluating and assessing the risk of systems failures. The potential for failures with a human factor is great—not just failures of individual humans, but more importantly, failure of management systems, equipment and infrastructure to be resilient enough to counter consequences of individual human failures.

Comment [CL21]: NOAA: If this is true, it merits a citation.

Comment [D22]: USCG: What is intent of this statement? It comes off as opinion without explanation. Harsh environment drilling experience can be found.

Comment [CL23]: NOAA: Was this a quote from someone talking about offshore drilling in the Arctic? If not, remove the quotations.

NOTE: Donald Winter said this in his presentation

6.1.1 Occupational Health and Safety vs Systems or Process Safety

A focus on occupational health and safety does not necessarily indicate a company's commitment to system safety or a positive safety culture. It is possible, as in the case of the Deepwater Horizon ~~accident~~incident, that operators and contractors can have a good occupational safety record~~,~~ while not adhering to safety of the complex systems and processes inherent in drilling in a frontier offshore area—Transocean managers were on board the Deepwater Horizon to celebrate seven years without a lost-time accident when the blowout and explosion happened. A company and their contractors who have a demonstrated a positive safety culture and pay close attention to systems safety will also have a good occupational health and safety program. A company with a good occupational health and safety program however, may not necessarily have an adequate safety culture nor pay enough attention to systems safety. This is clearly illustrated by the fact that Transocean managers were given a Safety Bonus in 2011 for the year 2010 in which the Deepwater Horizon was lost, with 11 crew, 9 of whom were

Comment [CL24]: NOAA: I am not familiar with this story, but would assume managers of the Deepwater Horizon rig were not given safety bonuses. It would help to explain, if this story is retained, how Transocean makes decisions on Safety Bonus awards.

Transocean employees, yet it was statistically one of their safest years of operation. It certainly was not one of their safest years for systems safety.

Occupational safety is measured ~~by~~ using lagging indicators~~,~~ such as lost works days, recordable injuries, and~~,~~ accidents~~, and other things that have already happened,~~ to detect trends which help improve performance. For systems safety this approach is not useful since we cannot afford to have many major accidents—enough to establish statistically valid trends. ***Leading indicators must be used, such as near-miss incidents, review of company records, meetings with the operator, worker surveys,*** *etc*..

Comment [D25]: NOAA: Edits

Comment [CL26]: NOAA: This recommendation could use more analysis to clarify its value. How might Transocean, for example, have fared in safety had leading indicators been taken into account?

6.1.2 Prescriptive vs Performance Based Regulation

Not enough is known about Arctic operations and there is not enough Arctic experience to support a classic prescriptive approach to regulation (Figure 1). To know what to prescribe in Arctic offshore oil and gas operations and codify them in regulations, one needs considerable history and experience and knowledge of detailed specific technical solutions. As can be seen from the numbers and history of wells drilled in the Arctic offshore in Figure 1, there is relatively little experience even compared to the number of onshore Arctic wells drilled and it is mostly decades old. .

Comment [CL27]: NOAA: How much more experience than exists today in the Arctic would be sufficient to employ prescriptive regulations?

Has the experience accumulated since the 70s' by US companies drilling and producing oil in the North Slopes does not provide experience and SOP from which to build on? Experience accumulated by other industry, state and local agencies, and SOP and best practices they developed?

Compared to the tens of thousands of offshore wells drilled in the Gulf of Mexico, where the Deepwater Horizon accident occurred, Arctic offshore experience is extremely sparse and possibly out-of-date. Performance-Based systems are more flexible allowing new technology and practices to be employed. Performance-Based regulatory systems place responsibility on operator. In this approach, the focus of the regulator is on prescribing processes and establishing objectives, as opposed to prescribing technological and design considerations.

Comment [D28]: USCG: Why limit comparison to the GOM? Wells are being drilled all over the world and in harsh environments.

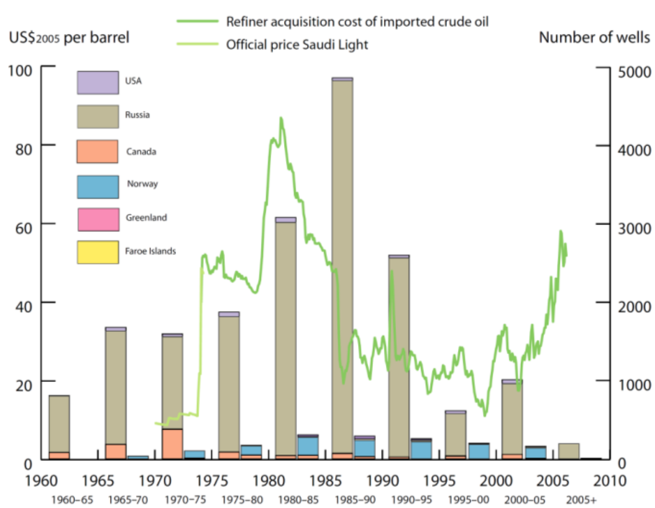

Figure 1. Number of exploration and discovery wells drilled in Arctic areas from 1960 to 2007 in 5-year increments, plotted against the oil price curve, adjusted for inflation to 2005 dollars, from the Energy Information Agency, 2007. Paired columns show onshore wells on left and offshore wells on right. Modified from OGA Chapter 2 Figure 2.2c (OGA, 2010).

The AOOGG (PAME 2009a p. 25) discusses prescriptive and performance-based approaches to regulation and found that most countries have a hybrid system consisting of components of both approaches. In a hybrid system, regulators prescribe processes, such as HSE management systems or safety culture, but the choice of those processes are up to the operator, as long as they satisfy the requirements set by the regulators and it fits the scope and nature of the operation.

6.1.3 Lessons Learned, Lessons Forgotten

Comment [CL29]: NOAA: This section should be re-written to fit the form of a recommendation which would match the adjacent sections.

Learning from pinnacle events such as the Piper Alpha or the Deepwater Horizon accidents tends to peak soon after the event and then starts to erode--~~through complacency, ignorance, or arrogance~~. And the lessons fade as memories or personal experience is lost with no organized way of passing those lessons learned to the next generation, such as through engineering schools or industry management educational programs. Lessons about deficient management systems being the root-cause of many past marine oil and gas accidents were re-taught in the Deepwater Horizon incident.

To apply these lessons to the offshore Arctic, where there is very little history of industry operations, will be harder still. The lessons from these accidents should constantly influence how operations are planned and carried out in the Arctic, and industry and regulators must strive to keep focused on the importance of not repeating the human-element mistakes of these offshore systems failure accidents.

6.1.4 Continuous improvement

To prevent a major accident from occurring during offshore oil and gas operations in the Arctic, the industry must implement, monitor, and continuously improve their management systems. The regulator also must continually improve its oversight by reviewing the regulatory system for clarity and effectiveness. Continuous improvement of offshore performance requires actions from and cooperation between industry and regulators.

Elements critical to ensuring continual improvement within the system include:

- Inspection;
- Measurement and Monitoring;
- Corrective and Preventive Actions;
- Records Management;
- Internal Audits, and
- Implementation of follow-up measures

In the Arctic offshore, where there are many uncertainties and little experience to draw from, it is imperative that performance is improved on a continual basis by systematically monitoring, assessing, and managing risk in these complex frontier operations. The regulator must continually evaluate and improve the way it influences the operator's safety performance, and the effectiveness of that influence.

For industry, continuous improvement in their management systems should be integrated throughout the whole process--from design to decommissioning and include

- Risk Assessments and analysis
- Audits, reviews,
- Follow-up measures

For the regulator continuous improvement is accomplished through

- Regulatory reviews and follow-up changes or clarifications
- Risk Based regulation
- Life Cycle Management
- Monitoring
- Inspections
- Enforcement

The process of continuous improvement is driven by data and information and the analysis of performance trends from that data. It is imperative that all safety and pollution incidents and near-misses be reported and analyzed in order to identify trends in safety performance and safety culture that indicate potential for a systems failure accident. It is also important that this information is made public.

Comment [D30]: USCG: Agree that trends should be public but not individual performance data.

6.1.5 Coordination of the Regulators

Coordination between regulators is essential to accident prevention. ***There is currently not one dedicated venue that deals with the specific issues related to Arctic offshore operations***. This issue was identified in several Deepwater Horizon investigations, Arctic hearings, and in discussions of the workshops. Formalized Arctic regulator coordination in some form has been recommended in the OGA, AOOGG, RP3 and Arctic Ocean Review Phase II Report (AOR) (PAME, 2013c). While there are some venues for regulators to meet regularly and share information and coordinate regulatory approaches, there is not one that deals with offshore Arctic specific issues. [Some examples of regulatory coordination are:

- International Regulators Forum (IRF): Since 1996. 4 Arctic Members (US, C, D, N). A group of eleven regulators of health and safety in the offshore upstream oil and gas industry. It exists to drive forward improvements in health and safety in the sector through collaboration in joint programs, and through sharing information.
- The International Committee on Regulatory Research and Development (ICRARD): ICRARD is focused on transferring knowledge in the area of health, safety and environment in the petroleum sector. www.icrard.org.
- North Sea Offshore Authorities Forum (NSOAF): Since 1987. Consists of representatives of authorities responsible for the supervision of offshore activities in North West Europe—there are 3 Arctic countries in membership (N, S, D-FI). It's stated aim: *"Ensure and encourage continuous improvement in Health, Safety, Environmental Care*

and the Welfare of offshore workers." Holds annual meetings and has five permanent working groups: Training, HS&E, EU (European Union), Wells and CCS (Carbon Capture & Storage).

- Oslo-Paris Convention for protecting the marine environment of the North-East Atlantic (OSPAR): Since 1998. Includes four Arctic country members (I, S, N, F) OSPAR Area 1 is the Arctic.
- EU Offshore Authorities Group (EUOAG) Since 2012. Two Arctic states are members (D, N). A forum for the exchange of experiences and expertise both amongst national authorities and between national authorities and the Commission on all issues relating to major accident prevention and response in offshore oil and gas operations within the Union, as well as beyond its borders, where appropriate. http://euoag.jrc.ec.europa.eu/
- G20 Global Marine Environment Protection (GMEP) was launched and a corresponding Working Group was created in 2010. G20 Leaders mandated that the GMEP Working Group develop a Mechanism for sharing best practices to protect the marine environment, to prevent accidents related to offshore oil and gas exploration and development, as well as marine transportation, and to deal with their consequences.
- Arctic Council. Since 1996. All Arctic states are members. Two working groups deal routinely with offshore oil and gas issues, EPPR and PAME and include national regulators in the delegations but participation varies. AMAP has an oil and gas expert group but no current plans to update the OGA. Under the Arctic Council two agreements were negotiated the SAR Agreement (Arctic Council, 2011) and the OSPR Agreement (Arctic Council, 2013) and a new Task Force for and agreement on oil spill prevention is on the Canadian Chairmanship agenda for 2013-2015.]

6.1.5.1 Common Arctic Standards and Practices

There are few Arctic-Specific standards, although some international standards are applicable in part, or in whole, to operations in the Arctic. Standards can range from specifications for equipment to goal-based guidance and best practices. As most Arctic nations are moving toward performance-based regulatory approaches, some standards will be focused on process more than on specification, such as HSE management systems, competency, performance measures, risk management, etc..

In other parts of the world, setting common high standards can be seen as a burden to smaller or moderate sized operators. However, Arctic offshore operations require well-capitalized companies, and that means only the majors will be able to play for the foreseeable future. Thus, it is more possible to require the use of the highest standards and to possibly harmonize them in this area.

Many existing and newly developed international standards may be appropriate in the Arctic and thus address to some extent the call for the call for the use of international standards in the Arctic (DOI, 2013; PC, 2011; NEB, 2011; AOR, PAME, 2013c; and EPPR, 2013a). However, systematic review of globally applicable international standards for suitability in the Arctic has only been done for a few of the available standards such as in the 2010

[8] http://euoag.jrc.ec.europa.eu/files/attachments/bonn_and_ospar_for_euoag.pdf

International Organization for Standards (ISO) 19906 Standards for Arctic Offshore Structures, or the Barents 2020[9] project where some 130 offshore standards were adopted or modified for common use in the Barents Sea. Efforts are underway in ISO for developing Arctic offshore oil and gas standards based on the results of the Barents 2020 program.

Standards are currently under development in ISO Technical Committee 67 (Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries), Subcommittee 8 (Arctic Operations) (TC67 SC8). These include:
ISO/AWI 18861 Petroleum and natural gas industries -- Arctic Operations -- Working environment (Working Group 1, Norway)
ISO/AWI 18819 Petroleum and natural gas industries -- Arctic operations -- Escape, evacuation and rescue from offshore installations (Working Group 2, Russia)
ISO/AWI 18820 Petroleum and natural gas industries -- Arctic Operations -- Environmental monitoring for offshore exploration (Working Group 3, Russia)

Additional ISO TC67 SC8 Standards Working Groups that have recently formed but are not listed yet in ISO's Project plans include:
WG 4 Ice management (Canada)
WG 5 Arctic materials (Norway)
WG 6 Physical environment for arctic operations (Norway)
WG 7 Man-made islands and land extension (Netherlands)

ISO and API are developing a harmonization of Arctic Structures Standards ISO 19906 and API RP2/N

[Standards by Reference versus Reference Standards
In a more prescriptive regulatory regime, standards are often required "by reference" where an established standard or best practice is referred to in the regulations. The United States has incorporated nearly 120 standards in their regulations, post-Macondo (PAME, 2013a). These include ISO, American Petroleum Institute (API) Recommended Practices (RP) 75, and standards from 6 other organizations. The API Center for Offshore Safety has recently produced 5 new documents on standards. These are not Arctic specific.

Canada, Norway, and Greenland, who have more performance-based regulatory regimes, do not typically require particular standards but set the goal to be achieved and allow the operators to use standards or best practices of their choice to meet those goals. However, Norway and Greenland do issue guidance which contains examples of reference standards that they support but do not require. Greenland uses the Norwegian NORSOK standards for reference in their Drilling Guidelines. Norway uses NORSOK and others as Reference Standards from several sources in their guidance to operators. They also, with Russia, have developed a set of offshore Arctic oil and gas standards for the Barents Sea in the Barents 2020 project. Both Russia and Norway plan to use these standards in this area, for Norway in their guidance as a recommended practice and for Russia possibly as State Standards (GOST-R).

[9] http://www.dnvusa.com/Binaries/Barents_2020_report_%20phase_3_tcm153-519577.pdf

Canada regulates with a combination of goal-oriented (performance-, or outcome-based) along with guidance and prescriptive requirements. Canada does not use reference standards but will require to the operator to comply with the regulations and fully follow the standards they chose and included in their filing documents and drilling approvals. The standards and practices chosen by the operators become required.]

6.1.6 *Management System Elements*

A comparison of requirements for Safety Management Systems of the Kingdom of Norway, Greenland, Canada, and the United States reveals many similarities. A table was constructed of 31 safety management system elements from 4 National Systems and the AOOGG HSE Recommendations that cross references these elements with the applicable laws and guidelines. The table is located on the PAME website www.pame.is (PAME MRE). [The Table is located in Appendix XX.]

These systems all have as a common and central feature a cyclic process involving sequential consideration of:

- policy and strategic objectives;
- organization, resources and documentation;
- risk evaluation and risk management;
- planning;
- implementation and monitoring; and
- auditing and review

AOOGG, 2009, p.26

Thirty one common or comparable safety management system elements were identified between Greenland, Norway, Canada and the United States.

[

1. Objectives and Strategies (Goals)
2. HSE Policies clearly stated or described
3. Show how Management is Committed to HSE
4. Planning
5. Documentation is current, valid and approved
6. Process for Periodic Review and Audit
7. Continued improvement
8. Measurement parameters and indicators (of the management system)
9. Quality Assurance/Mechanical Integrity
10. Operating Procedures/Work Processes
11. Internal Communications and Analysis
12. Risk Management
13. Risk Analysis
14. Hazards Analysis
15. Risk Acceptance Criteria
16. Safety/Working Environment Analysis
17. Decision basis and criteria
18. Training
19. Manning and Competence
20. Accountability for Contractors and all parties
21. Fit for place and purpose
22. Collection, processing and use of data

23. Reporting, review and investigation of hazards and accidents
24. Handling of situations/Emergency Response and Control measures
25. Identification of the responsible person(s) for system establishment, maintenance and implementation
26. Management of Change
27. Information requirements
28. Compliance Audits and Inspections
29. Issues of Non Compliance
30. Enforcement
31. Safety culture]

Many of these safety systems elements have been found to be at the root of major industrial disasters. In the Deepwater Horizon/Macondo well accident, planning, training, operating procedures, management of change, accountability, risk assessment/management, and safety culture were all found to be deficient and contributed to the accident, casualties, and oil spill.

6.1.6.1 Safety System Elements common in systems failure accidents

Studies have shown failure to effectively implement certain safety systems elements leads to major industrial accidents.

A study done by DnV for the National Energy Board Arctic Drilling Review on causes of 8 major industrial accidents showed failure in 4 main HSE Management Systems Elements:

Disconnect in Policies vs. Plan--Do–Check–Act *(Safety Culture)* a noted disconnect between the company's vision and policies (what they say) and their planning, implementation, monitoring and review (what they do).

***Policy, Commitment and Planning*.** Policy and Commitment statements were present in all accidents but planning elements were deficient

- hazard identification,
- risk assessments and
- related controls

Implementation. HSE Elements common to all of the accidents were

- the lack of communications, documentation and document control,
- operational control, and
- management of change.
- followed closely by lack of adequate training

Corrective Actions & Management Review. Checking and review elements are critical to ensuring continual improvement within the system and these were factors in all of the accidents.

- deficient inspections and monitoring;
- inadequate corrective and preventive actions to address identified deficiencies;
- poor records management
- poor internal audits, and
- lack of adequate management review.

In a BSEE analysis of 1000 Accident Investigations in the U.S. Outer Continental Shelf (PAME 2013a, p. 21), failure in addressing at least one of these safety management elements was found as a contributing/root cause in each of the 1000 incidents evaluated.

- Hazard Analysis
- Operating Procedures
- Quality Assurance and Mechanical Integrity
- Management of Change

A Study by St. Mary's College for the NEB on major systems failure accidents found that 14 out of 17 disasters studied contained cultural causes

- Tolerance of inadequate systems and resources (identified 10 times)
- Normalization of deviance (identified 9 times)
- Complacency (identified 8 times)
- Work pressure/cost (identified 4 times)

The workshops provided many recommendations, but one of these was that this report focus on certain elements of HSE Management Systems that have been found to be at the core of major accidents. Therefore these elements are selected for a closer look in the Arctic context:

- Risk/Hazards Analysis
- Management of Change
- Training and Competence for Arctic
- Accountability
- Operating Procedures
- Quality Assurance/Mechanical Integrity
- Documentation
- Communication

6.1.6.1.1 *Risk/Hazards Analysis*

Risks and hazards must be communicated clearly and understood by all who may affect, or be affected by, them. This is central to an effective management system. It is done through a formal process established by the operator and implemented throughout the whole company and may include training, communication, and clear responsibilities and the earnest pursuit of a positive safety culture.

Box 4: *They "don't always know what they don't know."* From a survey of the Transocean crew regarding "safety management and safety culture" on the Deepwater Horizon. PC, 2011

The National Investigation on the BP Deepwater Horizon Oil Spill found that a survey of the Transocean crew regarding "safety management and safety culture" was conducted on the Deepwater Horizon just a few weeks before the accident. The results of that survey found that Transocean's front line crews were "potentially working with a mindset that they believe they are fully aware of all the hazards when it's highly likely that they are not."

In the Arctic there are many hazards to human health, safety, and operational integrity not encountered elsewhere or hazards that are amplified in the Arctic, that must be accounted for in any risk or hazard analysis. These include extreme cold, moving ice, icing, darkness, fog, remoteness, offshore permafrost, ice gouging, subsea methane hydrates, and environmental sensitivities. The consequence risk of a common hazard found elsewhere, such as shallow gas or active faults, may be much different and extreme in the Arctic.

Reporting of "near-miss" data becomes particularly important given the lack of experience and history of operations in the offshore Arctic. It is important for ongoing risk analysis, safety culture, and continuous improvement to have all instances reported. Analysis can help others understand the risks and build safeguards into their operations.

Risk management is an integral part of an operators HSE Management System. Supplementing the example in the AOOGG (p. 88 Annex F) of an Environmental Risk Flow Diagram for evaluating risk, consider the use of Bow-Tie Risk diagrams to improve barrier management and risk margin monitoring.

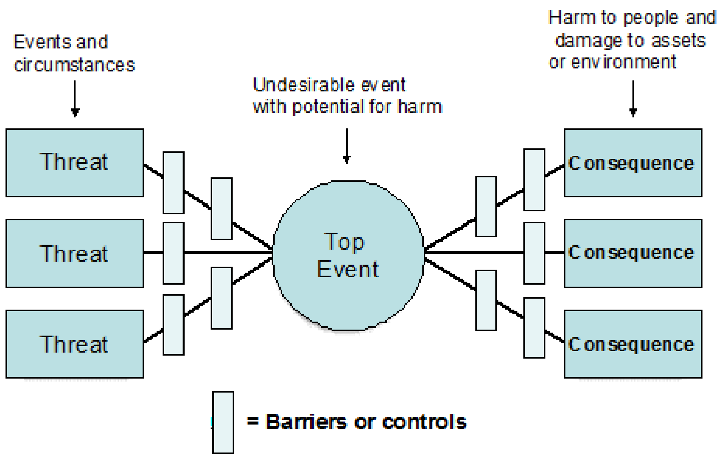

Figure 2. Example of a Bow-Tie Risk Diagram (need attributable example)

Use of Failure Modes & Effects Analysis allows the assessment of the ability to monitor and to check risk levels and margins. This can be factored into a Bow-Tie analysis, where risk levels and margins become much more evident and help in the overall risk evaluation.

6.1.6.1.2 ***Management of Change***

Management of change is vitally important in Arctic operations where environmental conditions are dynamic and restrictive, communications may be difficult, and personnel are under work pressure in a short drilling season. Due to limited experience in complex offshore

Arctic operations, limited immediate availability of some personnel and equipment, and new challenging environmental and geological conditions, extra resilience needs to be built into the system to account for managing associated changes to plans, personnel, equipment, procedures, or operations.

6.1.6.1.3 ***Training and Competence for Arctic***

Specialized training for cold weather operations, firefighting, emergency and environmental response and other aspects including cultural sensitivity will be required of personnel working in the Arctic. This includes mechanical, psychological, operational, and processes or systems training. Cross-training will be necessary for personnel who may be required to fill-in for or assist primary personnel in critical operations due to either limited vessel occupancy capacity or in case of emergency response.

Comment [CL31]: NOAA: Believe some of these have been worked out in US, Canadian, Norwegian, Russian operations.

Qualified and Arctic experienced personnel may be difficult to recruit; personnel may have to be competent in more than one responsibility under extreme and isolated conditions with limited communications and transport capability. In Arctic operations, it is particularly important to have the best trained and competent crew because self-sufficiency is necessary with fewer available persons, longer rotation schedules, and difficult and sometimes impossible shore-to-rig transport.

For the regulators, a performance-based regulatory regime involves a wider scope of oversight requiring personnel with more and different skills than a typical prescriptive regime. It can be compared to going from being a cop-on-the-beat to a major-crimes detective; both are police, but have far different skill sets. Instead of inspecting facilities and equipment, checking boxes on compliance forms, and issuing notices and citations, the process for reviewing, monitoring, auditing, improving and enforcing safety and environmental performance in a performance-based regime, requires more people, training and support.

6.1.6.1.4 ***Accountability***

In Arctic offshore operations it is critically important to have accountability and responsibility clearly defined and understood by the operator, contractors and regulators. The operator has to be responsible for safety and environmental protection. In complex Arctic offshore operation with many uncertainties, the operator is the only one with the knowledge and understanding of the whole operation, overall risks involved, and the margins of safety. Standard communication processes do not necessarily transfer to the Arctic and can challenge the lines of authority and communication between the theatre of operations and the home office and even the drill floor and the control room.

Everyone has personal accountability for safety, which is fostered by a positive safety culture.

6.1.6.1.5 ***Operating Procedures***

The Arctic is different with many extra challenges to the standard operating practices and work processes, which may not be adequate or appropriate to Arctic conditions. Operating procedures are affected by darkness, extreme cold, ice, extreme weather, structure icing, environmental sensitivity, remoteness; and short exploratory drilling season putting pressure to get the job done. All Arctic offshore operating procedures and work processes require carefully thought out modifications and additional procedures, with an emphasis on safety and environmental protection. ***The misuse, poorly applied, or absence of proper operating practices is a common factor in many offshore accidents and should be a focus of the industry and regulators in the Arctic.***

Comment [D32]: USCG:. Provide data to back up? References in following paragraph address environment, but can't find direct info/example in those on how short season creates challenge

Many examples of these Arctic elements that can affect operational procedures are in reports by the BSEE and PSA; *Technology and Operational Challenges for the High North*, 2011 by the International Research Institute of Stavanger and the University of Stavanger for PSA (IRIS, 2011), and the *Arctic Offshore Technology Assessment*, by American Global Maritime, Inc. for BSEE (AOTA, 2011).

There are efforts underway to standardize some of these operating practices, most notably in the International Organization for Standardization (ISO)[10] and these are discussed earlier in section 6.1.5.1 on Common Arctic Standards and Practices

6.1.6.1.6 ***Quality Assurance/Mechanical Integrity***

Equipment and facilities must withstand extra stress in Arctic offshore operations and are more prone to failure from environmental conditions, needing extra attention compared to other regions. Equipment and facilities may require especially hard to get or hard to replace components and with a compressed exploratory drilling season may place extra pressure to perform makeshift repairs or delay maintenance in order to make it through the program on time.

Comment [D33]: USCG: Any data to back this up? Tie in examples below to why compressed season caused these.

Quality control of processes and equipment played a role in the Deepwater Horizon/Macondo well disaster, from a poor cementing job, to too few and improper centralizers for the casing. The assessment of Shell Oil Company's 2012 operations in Arctic Alaska found that contaminated fuel on the towing vessel and the failure of a shackle of dubious origin on the tow rigging contributed to the grounding of the Kulluk Drilling platform while being towed from Alaska to Seattle.

6.1.6.1.7 ***Documentation***

Accurate onsite documentation may be challenged by working and environmental conditions, and timely documentation may be compromised by shortened exploratory drilling season as compared to other regions. Operational changes due to sudden harsh environmental conditions or unexpected equipment issues may go undocumented due to schedule pressure. Approval of documents may be more difficult for Arctic operations due to short drilling season and remoteness from and possible communications difficulty with the home office and the regulators.

Comment [D34]: Any data to back this up?

6.1.6.1.8 ***Communications***

Communications between the home office and drilling unit can be delayed or interrupted requiring back up systems or contingencies. Communications on the drilling rig may be

[10] Barents 2020, ISO Standards for offshore structures, and new TC67 initiatives for Arctic operations.

difficult or may be deferred due to environmental conditions of extreme cold or extreme weather. In a short exploratory drilling season, pressures for completion of the program may tend to diminish important communications between the different operations groups.

Comment [CL35]: NOAA: Communication is more likely difficult due to lack of infrastructure and decreased satellite coverage at high latitudes.

Comment [D36]: USCG: Any data to back this up?

6.1.7 Safety Culture

Although safety culture is considered to be a safety management systems element, it touches all other elements and is integrated in a company's operations from top to bottom. With all else equal (use of tested management systems, excellent standards, best technology and practices), an organization without a positive safety culture is more likely to experience a low probability/high consequence disaster. It is clear from case studies of accidents and management systems, that government has a role in ensuring that the operations management has a positive safety culture. Therefore, guidance is primarily aimed at what Arctic countries can do to promote safety culture in the industry it regulates.

> **Box 6:** An important management tool to assist the operator in meeting the regulatory objectives of either system, eliminating unsafe behavior, and achieving continual improvement in safety and pollution prevention practices is defining and communicating a culture focus on safety and environmental performance to the workforce and ensuring that they are fully motivated to implement it through a management system. AOOGG, 2009 p. 25.

Several definitions of safety culture are contained in the workshop findings and recommendations in Appendix 1.

Safety culture must be defined, understood, and clearly communicated by operators to everyone in their operations, including contractors, and to the regulators. This includes a process to put in place a consistent policy for safety culture that:

- Says the organization has a safety culture and defines it,
- Has a process to support and improve Safety Culture, and
- Has a solid methodology to actually assess the extent that they are really doing what they say they are doing.

6.1.7.1 Indicators and Metrics

- Onsite visits
- Document review
- Employee surveys
- Audits
- Near incidents

> **Box 5:** ***Safety culture is the product of individual and group values, attitudes, competencies and patterns of behaviour that determine the commitment to, and the style and proficiency of an organization's health and safety programmes.*** (Advisory Committee for Safety in Nuclear Installations, 1993; p. 23)

6.1.7.2 Near-Miss Reporting

- Leading indicator—used in tracking trends in systems safety performance before an accident or other incident
- Not defined
- Not always required
- Data are often proprietary
- No comprehensive database for Systems failure near misses
- No standardized analytical methods for comparable trends

6.1.7.3 Common Cultural Elements in Systems Failure Accidents

- Tolerance of Inadequate Systems or Resources
- Complacency
- Deviation from Safety Policy becomes Normal and Accepted
- Work Pressure

6.1.7.3.1 Normalization of deviance *"SNAFU--Situation Normal All Fouled Up"*

The Deepwater Horizon/Macondo accident has been shown to have occurred due to a series of human errors and bad judgments that were made without careful consideration of the risk or consequence. For such a sequence of bad judgments and decisions to take place, it becomes clear that systems safety was not part of the culture that existed on the Deepwater Horizon, allowing for inadequate systems, and which normalized deviance.

6.1.7.3.2 Complacency *"Can't happen here, Can't happen to me, Can't happen again"*

Complacency stemming from looking at the wrong indicators of systems safety is a risk factor for low probability-high consequence accidents. Occupational safety was being rewarded on the Deepwater Horizon Platform when the blowout occurred. ***Safe work records and no-loss work days do not indicate a positive Safety Culture nor serve as reliable indicators of systems safety--the type of safety that prevents disastrous accidents.*** Acceptance and belief in an exceptional occupational safety record or a company's own public relations statements about safety can offer a false sense of security and result in complacency and acceptance of substandard conditions or tolerance of inadequate systems or resources.

…the receipt of safety awards is a "predictor" of major safety incidents. Winning of safety awards should be the biggest warning sign to a company that complacency may be an issue.

Compared to mature offshore petroleum provinces, the Arctic offshore is a frontier area. There is no basis for complacency or over-confidence despite that fact that there have been no major accidents in the Arctic offshore, because there have been so few wells drilled and the institutional knowledge and experienced personnel have been mostly lost.

Comment [D37]: USCG: Mentioned previously. Please provide an explanation of who these qualified/knowledgeable people were and when/why they were lost.

Operators and regulators should always experience "Chronic Unease" to avoid complacency.

6.1.7.3.3 Tolerance of Inadequate Systems or Resources *"No Cowboys!"*

A change in culture is needed from "Can Do" to one of Safety, and there is no room for the trial and error, high-risk operating practices, and makeshift adapt-on-the-fly technology used in the past. "Can do" needs to be replaced with "Can do safely, or won't do."

Both the oil and gas industry and many "northerners" share a history of adaptation and innovation to live or operate in new challenging conditions—a pioneering attitude and culture that often accepted higher levels of risk. For northern settlers this meant adaptation of southern ways of doing things to the north. This often entailed extensive and costly trial and error methodologies without assessing the risk or having a high tolerance for risk. But as the adaptation occurred over time, and innovations were successful, it led to a "can do" attitude and culture that glorified "finding a way to get it done." Making do with what is available such as fixing your airplane with tape and wire, or repairing machines or buildings with local materials, is part of the lore that persists in the North.

In Arctic onshore oil fields, many southern exploration and development techniques and technologies were imported to the north and most failed to some extent resulting in accidents and environmental damage. But with the prevalent "can do" attitude, lessons were learned and the technologies and practices were modified to correct inadequacies or mistakes made. Arctic offshore oil and gas operations experienced this frontier "can do" attitude and culture first in the late 1970's and mid-1980's when Arctic offshore exploration was at its peak (Figure 1). Fortunately, there were no major Arctic offshore incidents during this "frontier" period, but the lack of major incidents gives a sense of confidence that is perhaps misplaced. We can no longer afford to operate this way.

6.1.7.3.4 Work Pressure ~~"Get 'er done"~~

Comment [D38]: USCG

The costs associated with, and time and personnel constraints on, frontier oil and gas activities, all increase work pressure which makes an accident more likely to occur. Operations like the Macondo deepwater well in the Gulf of Mexico are very expensive endeavors. Any setback in schedule is measured in millions of dollars a day. This cost awareness put pressure on the management and drilling team of the Deepwater Horizon and affected their decisions that, at least in part, caused the accident. Arctic drilling operations are also complex and expensive—up to $60 million per exploration well (AMAP, 2010 p.2_12) even in shallow water. Pressure to complete the work could be easily enhanced by a shorter drilling season, and by such things as harsher operating environment and fewer crew changes. Again the "Can Do" attitude prevalent in the industry must be replaced with risk adverse approaches.

6.2 [Recommended] Guidance

6.2.1 Arctic Offshore Oil and Gas Guidelines, 2009

It is important to first recognize the existing relevant guidance on HSE Management Systems that the Arctic Council has agreed upon as contained in the AOOGG, 2009. The topic and page number are listed below and the text is contained in Appendix 2 for easy reference.
[Text Bracketed: A suggestion has been made to not list this in detail here. Other opinions are that it is a convenient guide to the relevant sections of the AOOGG at this point]
[Safety and Environmental Management (p. 25)
- Management Systems (p. 26)
- Policy and Strategic Objectives (p. 26)
- Organization, Resources and Documentation (p. 27)
- Evaluation and risk management (p. 27)
- Risk Assessment and Environmental Risk Analysis (p.16)

Building on the AOOGG, the following [recommended] guidance is meant to supplement and enhance guidance to improve safety and environmental protection performance in Arctic offshore oil and gas operations.

It is recognized that authorities from Arctic states are engaged in many initiatives and programs to respond to the risks of systems failure accidents in the Arctic offshore. It is also recognized that Arctic states have different systems of regulation defined by their operating conditions, national culture and social, political, and economic needs, and that those systems are of differing maturity. Therefore, the following recommendations may be, in part or in whole, already in place or in the process of being implemented. However, no one can simply say “we do that already” because improvement is a continuous process. It is important to change the “business as usual approach while operating the Arctic (PC, 2011 and DOI, 2013).

6.2.2 Continuous Improvement

An important principle stated in the AOOGG is that countries and industry strive for continuous improvement.

Box 7: All parties should continually strive to improve health, environment and safety by identifying the processes, activities and products that need improvement, and implement necessary improvement measures. The process of identifying what can be improved may be based on mappings and results of analyses, investigation of situations of hazard and accident, or near hazards and accidents, handling of non-conformities, experience from internal follow-up or auditing, or experience gained by others. AOOGG, p. 6

6.2.3 HSE Management Systems

Improve Management of Change--Including risk analysis processes and tools for better handling of changes to the drilling plan during the operational phase.

Delta Arctic: For each critical procedure or operation a complete assessment of risks with a risk assessment matrix or other methodology taking into account the full range of Arctic multipliers should be undertaken.

6.2.3.1 *Risk/Hazards Analysis*

- Require the operator to continually assess risk because you learn as you go in Frontier Areas. Factors include:
    - Geology in the well
    - Weather, sea, ice
    - Improve management of change
- Require the operator to continuously assess risk to inform the process of improving regulatory, operator, and industry guidance, standards and regulations.
- Require the operator to continuously assess risks associated with technological solutions to improve process safety performance before an accident happens.
- Consider use of a Risk Based Life Cycle (RBLC) regulatory approach.

Box 8: A risk analyses should:
- address prevention of injuries, loss of human life, and pollution of the environment;
- include risk criteria that has been defined prior to conducting the analysis and document the evaluations forming the basis of the acceptance criteria;
- be used to follow the progress of activities in planning and implementation;
- identify risk that has been assessed with reference to the acceptance criteria, form the basis of systematic selection of technical operational and organizational risk to be implemented;
- be updated on a continuous basis and included as part of the decision making process; and
- systematically follow-up implemented risk reducing measures and assumptions made in the analysis to ensure safety within the defined criteria. AOOGG, p. 36

Risk Management/Operational Controls
- Require Monitoring of Risk and Risk Margins

- Require improvement of Barrier Management
- Require improvement in Situational Awareness (i.e. weather, ice, sea conditions)
- Require Additional Instrumentation; do not rely on indirect measures.
- Require real-time operations centers for all wells being drilled in the offshore Arctic. Government regulators should be involved in real-time monitoring at major points in the operations—such as negative pressure tests and other critical operations. The regulator should be knowledgeable and trained in the operations being monitored.
- Consider using the multi-lingual ISO 31,000 High Level Risk Management Guidelines for common terminology and communications.
- Require integrated risk assessment and analysis for the whole operation

Safety Margin Management should be used as a proactive approach to ensure establishment of margins of safety in the design phase. Have the operator

- Define what is adequate.
- Establish proven practice.
- Assess uncertainties and adjust levels of margins.
- Factor in the differences in exploration and production operations and geology and Arctic multipliers.

6.2.3.2 Quality Assurance/Mechanical Integrity

Due to the harsh and remote operating environment in the Arctic, it is vitally important that critical equipment is monitored and maintained and that all components are certified by the manufacturer and properly used by the operator. Maintenance management can be challenged by remoteness to repair parts and components, and difficult working conditions that can affect access to equipment, and record keeping,

6.2.3.3 Responsibility and Accountability:

- The operator should always be the responsible party safety because only they have the overall picture of the complex operations and systems and only they have access to all of the information and data needed to make critical decisions.
- The operator is responsible for their contractors (training, competence, certification, HSE Management systems, safety culture, etc.).
- Hold the operator accountable for developing a comprehensive Management System and robust safety culture and audit their operations to observe and validate the Management System and safety culture.
- Require the operator to define who is responsible at all times for critical decision-making processes.
- Require the operator's responsible authority to sign all management systems and safety culture documents and reports and assign individual civil and criminal liability for certifying their management systems.
- Train the government auditors for competency and provide the necessary support to ensure adequate and appropriate oversight.

Comment [D39]: USCG: What happens to the corporate leader when a worker, on the drill floor, misses a tell tale and the well blows out? Perhaps add something that draws on punishing those who sign off on a management system found to be inadequate.

- Governments should make provisions to fully fund and support a trained and competent regulatory and management staff in accordance with the activity level going on in the country.

6.2.3.4 Information and Reporting

Continuous improvement is based on data from reviews, audits, inspections, surveys and reports. All data should be submitted or shared regularly within the company, between operators and with the authorities. Operators should be prepared to make public their safety plans, contingency plans, emergency response plans, and environmental protection plans.

The reports from compliance monitoring activities should include the following information:
(a) legal basis for carrying out compliance monitoring;
(b) background for carrying out the specific monitoring activity;
(c) issues covered during the inspections or audits;
(d) non-compliances or deviations found, as well as other observations;
(e) requirements regarding correcting non-compliances or deviations, including time lines and needs for reporting back to the authorities; and
(f) listing parties taking part in the inspections or audits.
The reports should be available to the public. AOOGG, p. 29

Share data, methodologies, analysis, and trends between operators and regulators and make it publically available.

6.2.4 Near-Miss Reporting

- Define near misses. Such as body-to-body incident definitions, well kicks, etc. possibly through IRF as part of the Common International Incident Reporting Requirements or other initiatives such as within the ISO.
- Require mandatory reporting and analysis of near-misses to identify trends before an accident happens.
- Find a way around the "proprietary" nature of some information on near misses.
- Make data publically available.
- Standardize analytical methods for comparable trends by coordination between regulators and industry or in government regulator forums.
- Develop a Worldwide near-miss database

6.2.5 Safety Culture

Box 9: ***Industry and regulators should foster an effective safety culture though consistent training, adherence to principles of human factors, system safety, and continued measurement through leading indicators.*** (NAE, 2011)

- Demand a positive safety culture.
- Require operators to define their safety culture.
- Require operators to define how they will instill the culture in the workforce
- Require operators to have a verifiable process to improve safety culture that monitors and assesses safety culture through leading indicators, such described in the Safety Culture workshop (PAME, 2013b, p. 47).

Comment [D40]: USCG: Why? What is intent if it is public?

Comment [D41]: USCG: Why? What is intent if it is public? Consider providing proactively or requiring provided to regulatory and oversight bodies.

Comment [D42]: USCG: Won't need to "find a way around" if not made public.

- Require operators to define indicators of positive safety culture.
- Require operator to identify a responsible and accountable person for their safety culture.
- Share indicators of safety culture through some inter-governmental/industry mechanism.
- Conduct audits on a risk-based prioritization schedule and use the results to address improvement opportunities in the management system and safety culture.
- Financial incentive and disincentives:
    - View the safety and environmental record of the whole company as an indicator of performance.
    - Tie safety and environmental performance to lease or license qualifications
    - Tie safety and environmental performance to management compensation such as by instituting legislative "clawback" provisions for bonuses (using the USA Sarbanes/Oxley Act for financial institutions as an example).
    - Enact Whistle-Blower provision and protection guarantees.

Comment [D43]: USCG: This needs to be the CEO.

6.2.6 Coordination

- Industry and the regulators must work together to institute, implement, monitor, and continuously improve HSE Management Systems and safety culture in the Arctic offshore oil and gas operations.
- Establish or promote international drilling standards.
- Establish an Arctic Offshore Regulators Forum or an Arctic focused group within an existing body or forum, to address and share knowledge of offshore Arctic-specific, or applicable issues, and for defining and standardizing near-miss incidents and reporting.

Box 10: Facilitate oil spill prevention research and regulatory cooperation:
It is recommended that the Arctic Council establish a mechanism whereby regulators are able to share experiences, practices and compliance and operational information (e.g. near-miss data). RP3 Summary Report Recommendation number 5.

Box 11: *Arctic countries should establish a mechanism through which to share experiences, and should coordinate and cooperate concerning their methods of risk and impact assessments and management of the oil and gas industry.* From Recommendation 5,. OGA Chapter 7, p. 7_15

6.2.7 HSE and Safety Culture Workshop Recommendations

Arctic states are urged to review the Recommendations of the HSE Management Systems and the Safety Culture Workshops contained in Appendix 1 and consider these for future regulatory and industry performance improvements.

7 References

A Field Guide to Oil Spill Response in Arctic Waters, EPPR

AMAP, 2010 AMAP Assessment 2007: Oil and Gas Activities in the Arctic—Effects and Potential Effects (OGA)

Arctic Council, 2011. Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic.

Arctic Council, 2013. Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic.

Arctic Guide for Emergency Prevention, Preparedness and Response, EPPR

AOTA, 2011: Arctic Offshore Technology Assessment, 2011. American Global Maritime, Inc. for the Bureau of Safety and Environmental Enforcement, USA. http://www.bsee.gov/uploadedFiles/BSEE/Research_and_Training/Technology_Assessment_and_Research/tarprojects/600-699/678AA.pdf

Arctic Region Oil Spill Response Resource and Logistic Guide, EPPR

Arctic Response Cooperation Guidelines, EPPR

Arctic Shoreline Clean-up Assessment Technique (SCAT) Manual, EPPR

Barents 2020, 2012 Report on Standards development for the Barents Sea by DnV

Circumpolar Map of Resources at Risk from Oil Spills in the Arctic, EPPR

DOI, 2013. Department of Interior Assessment of Shells 2012 Arctic Drilling Program, 2013

Environmental Risk Analysis of Arctic Activities, EPPR

EPPR 2013a Recommended Practices for Arctic Oil Spill Prevention (RP3)

EPPR, 2013b.Operational Guidelines for Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic

Guidelines for Transfer of Refined Oil and Oil Products in Arctic Waters, PAME

IRIS, 2011. Technology and Operational Challenges for the High North, 2011 by the International Research Institute of Stavanger and the University of Stavanger for PSA

NAE, 2011 Macondo Well–Deepwater Horizon Blowout: Lessons for Improving Offshore Drilling Safety Offshore[11] by the Committee for Analysis of Causes of the Deepwater Horizon Explosion, Fire, and Oil Spill to Identify Measures to Prevent Similar Accidents in the Future, NAE, 2011. National Academy of Engineering, December 2011 http://www.nae.edu/Activities/20676/deepwater-horizon-analysis.aspx

NEB, 2011. National Energy Board of Canada Canada Arctic Drilling Review http://www.neb-one.gc.ca/clf-nsi/rthnb/pplctnsbfrthnb/rctcffshrdrllngrvw/rctcffshrdrllngrvw-eng.html

PC, 2011. National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling Report to the President www.oilspillcommission.gov

Operational Guidelines for Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic, EPPR.

PAME 2009a Arctic Offshore Oil and Gas Guidelines (AOOGG)

PAME, 2009b Arctic Marine Shipping Assessment

PAME 2013a Report—Findings and Recommendations of the Health Safety and Environmental Management Systems Workshop http://www.pame.is/images/PAME_Ministerial_2013/HSE_Workshop_Report_10-12_June_2012.pdf

PAME 2013b Report—Findings and Recommendations of the Safety Culture Workshop http://www.pame.is/images/PAME_Ministerial_2013/Safety_Culture_Workshop_Report_16_Sep_2012.pdf

PAME 2013c PAME 2013c Arctic Ocean Review Phase II

PSA, 2011 The Deepwater Horizon accident—assessment and recommendations of the Norwegian Petroleum Industry http://www.ptil.no/getfile.php/PDF/DwH_PSA_summary.pdf

Technology and Operational Challenges for the High North, 2011. International Research Institute of Stavanger (IRIS) and the University of Stavanger for the Petroleum Safety Authority of Norway.

The Deepwater Horizon accident: Causes, learning points and recommendations for the Norwegian continental shelf" SINTEF

Appendix 1

Findings and Recommendations of the HSE Management Systems and Safety Culture Workshops

This section contains some of the findings and recommendations of the two offshore oil and gas workshops that were held in support of this project. The full reports with all presentations and discussions are published separately by PAME (PAME, 2013a[12] and 2013b[13]). These findings and recommendations are the opinions of experts and stakeholders at the workshops.

The first workshop was on HSE Management Systems held in Keflavik, Iceland during June 10-12, 2012. The second workshop was on Safety Culture and was held in Halifax, Nova Scotia, Canada, September 16, 2012. Both of these workshops convened international experts from governments, various industries, and academia, indigenous peoples organizations, and other Arctic stakeholders for full one-day presentations and discussions. Both workshops were well-attended by respected experts and stakeholders despite both being held on a Sunday.

Workshop participants were asked to consider particular issues for discussion, but were encouraged to contribute their expertise on any topic or subject they felt important. Therefore, the main themes covered in the workshops were determined to a large extent by the flow of the discussions.

The HSEMS Workshop discussed; 1) investigations of the DwH accident and lessons learned that relate to Arctic operations, 2) HSE management systems requirements of selected Arctic countries, 3) results of recent changes in Arctic regulatory regimes, and 4) in open session, various HSE elements that might need more focus in an Arctic context. The issue of safety culture was clearly identified as ~~as~~ a priority issue, and warranted a separate workshop to explore further.

The Safety Culture Workshop consisted of invited experts from various industries, government bodies, and academia who presented on the subject of "safety culture" as it applies to the prevention of systems/process failure accidents and pollution incidents.

The findings and recommendations from both workshops were combined because many common topics and issues were discussed in both. In addition, a separate summary of findings and recommendations from each workshop would result in doubling the length of this section and contains many redundancies.

The workshop findings and recommendations are arranged under common themes that were derived from the presentations or discussions at the workshops. The findings and recommendations do not necessarily follow the sequence they may have been presented in, nor from which workshop they came. They are also not attributed to any presenter or participant. That information is contained in the workshop reports (PAME 2013a and 2013b). The two

[12] http://www.pame.is/images/PAME_Ministerial_2013/HSE_Workshop_Report_10-12_June_2012.pdf
[13] http://www.pame.is/images/PAME_Ministerial_2013/Safety_Culture_Workshop_Report_16_Sep_2012.pdf

workshop reports were reviewed and the main findings and recommendations made by people in presentations or discussions were collected, summarized, and placed under common themes. Some themes were determined by the structure of the workshop presentations, while others came from discussions either after a presentation or in the open discussion sessions.

The information from these workshops is central to PAME for the findings and guidance in this report.

Findings and Recommendations: Investigations of the Deepwater Horizon/Macondo Well Accident and Regulatory Reviews

After the Deepwater Horizon/Macondo well disaster in the Gulf of Mexico April-July 2010, many investigations were begun by government appointed bodies and regulators (See Appendix 3).

While most of these investigative findings and recommendations are specifically aimed at the Deepwater Horizon/Macondo well incident, the findings clearly show the root causes of the accident are common to all systems failure accidents and indicate problems with safety culture and management systems in the offshore petroleum industry in particular.

At the invitation of PAME, several participants in the HSE Management Systems and Safety Culture workshops presented the results of national investigations into the Deepwater Horizon/Macondo well disaster or the results of subsequent regulatory reviews. The first five of the summaries are from these workshop presentations.

6. Macondo Well–*Deepwater Horizon* Blowout: Lessons for Improving Offshore Drilling Safety Offshore by the Committee for Analysis of Causes of the Deepwater Horizon Explosion, Fire, and Oil Spill to Identify Measures to Prevent Similar Accidents in the Future, National Academy of Engineering, December 2011
7. Deep Water: The Gulf Oil Disaster and the Future of Offshore Drilling, Report to the President by the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling[14], January 2011
8. State of Alaska Oil and Gas Conservation Commission Hearings on Drilling Safety September 15-16, 2011
9. National Energy Board of Canada, Arctic Drilling Review
10. Petroleum Safety Authority Report--The Deepwater Horizon accident—assessment and recommendations for the Norwegian Petroleum Industry

Additional information was drawn from published reports including:

3. Petroleum Safety Authority Report--The Deepwater Horizon accident—assessment and recommendations for the Norwegian Petroleum Industry
4. Department of Interior Assessment of Shell 2012 Arctic Drilling Program, March 8, 2013

[14] National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling Report to the President www.oilspillcommission.gov

4.1 Macondo Well–*Deepwater Horizon* Blowout: Lessons for Improving Offshore Drilling Safety Offshore[15] by the Committee for Analysis of Causes of the Deepwater Horizon Explosion, Fire, and Oil Spill to Identify Measures to Prevent Similar Accidents in the Future, National Academy of Engineering, December 2011

This committee was formed to report on the loss of the Macondo well and Deepwater Horizon drilling vessel in response to a request from the Secretary of Interior of the United States to the National Academy of Engineering.

Findings

Lack of fail-safe design, testing, training, and operating practices, aboard the rig contributed to the loss of rig and life.

Other contributing factors in the accident include:

- multiple non-integrated and flawed decisions,
- no systems approach to safety,
- no one looking at totality of the operation,
- no one monitoring the margins of safety,
- no one looking at the totality of risk.
- no strong safety culture
- failure by the operator and contractors to understand changes and consequences
- there was apparent confusion between systems and occupational safety
- unclear accountability

Management and Safety Culture

- The lack of a strong safety culture resulting from a deficient overall systems approach to safety is evident in the multiple flawed decisions that led to the blowout.
- Industrial management failed to appreciate or plan for the safety challenges presented by the Macondo well.
- The complex structure of the offshore oil and gas industry and the divisions of technical expertise impacts the ability to perform and maintain an integrated assessment of the margins of safety.

Recommendations for Industry

- Operating companies should be held responsible and accountable for well design, well construction, and suitability of rig and safety equipment. The drilling contractor should be held responsible and accountable for the operation and safety of the offshore equipment.
- Industry should
  –Greatly expand R&D to improve overall safety of offshore drilling.
  –Significantly expand the formal education and training of industry personnel engaged in offshore drilling to support proper implementation of system safety.
  –Foster an effective safety culture through consistent training, adherence to principles of human factors, system safety and continued measurement through leading indicators.
  –Ensure timely access to demonstrated capping and containment capabilities.

Recommendations for Regulators

[15] http://www.nae.edu/Activities/20676/deepwater-horizon-analysis.aspx

- Improve corporate and industry-wide systems for reporting safety-related incidents.
- Designate a single U.S. government agency with responsibility for ensuring an integrated approach for system safety for all offshore drilling activities.
- Significantly expand the formal education and training of regulatory personnel engaged in offshore drilling roles.
- Implement a hybrid regulatory system integrating a limited number of prescriptive elements into a pro-active, goal-oriented risk management system.

4.2 Deep Water: The Gulf Oil Disaster and the Future of Offshore Drilling, Report to the President by the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling[16], January 2011

This report commissioned by the President of the United States after the Macondo well blowout and resultant enormous Gulf of Mexico oil spill, contained a forward looking section on the challenges of working in Frontier areas, including the Arctic, in anticipation of the resumption of oil and gas operations in the U.S. Chukchi and Beaufort Seas.

Findings:

- The Deepwater Horizon disaster was foreseeable and preventable
- The immediate causes of the Macondo well blowout can be traced to a series of identifiable mistakes made by BP, Halliburton, and Transocean
- The decisions made by these companies reveal systemic failures in risk management and raise questions about the safety culture of the industry.

Special Challenges in the Arctic

- Cold, dark, remote, extreme weather, inadequate charting, communications, training, infrastructure, underdeveloped technology appropriate to conditions, lack of knowledge about the ecosystems, very vulnerable environment, and indigenous populations dependent upon healthy marine mammals, fish, birds, etc.

Recommendations for the Arctic

- Drilling must be done with the utmost care because of the sensitive Arctic environment
- Safety Culture: The oil and gas industry must adopt a "culture of safety" as a collective responsibility with a focused commitment to constant improvement and zero failure rate and set up mechanisms to implement
- Incident/near-miss reporting should be public
- Providing protection for "whistleblowers" for safety problems
- Develop management system incorporating "safety case" approach

Comment [D44]: USCG: Shouldn't this be the case worldwide?

Comment [D45]: USCG: Why? What is intent if it is public? Consider providing proactively or requiring provided to regulatory and oversight bodies

4.3 State of Alaska Oil and Gas Conservation Commission (AOGCC) **Hearings on Drilling Safety**

Alaska Hearings on Drilling Safety September 15-16, 2011 were held to assess if the State of Alaska needed to change their regulations in the aftermath of the Deepwater Horizon incident. A study was done for the AOGCC and discussed at the hearing. The Report findings included:

[16] National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling Report to the President www.oilspillcommission.gov

Don't blame deep water. The loss of well control and subsequent systems failure that led to explosions, fire, and sinking, and loss of life and a massive oil spill, is not just a problem restricted to deepwater type of operations. It can happen in any frontier area where operations are complicated and complex, such as the Arctic offshore.
Demand a safety culture. Safety culture and continuous improvement for regulators and operators**,** from every level, is not an optional extra. It must be demanded, guided, measured, verified, and improved.
Eliminate regulatory complexity. Complex regulations and overlaps and gaps, made understanding compliance and communication responsibility and accountability difficult.
Conduct inspections, enforce regulations, and monitor performance. Violations of regulations by the operator, soft penalties, lack of inspections by the regulator combined with, poor monitoring of the operators performance, greatly increases the risk for a major accident. Performance monitoring is critical for identifying problem trends. Monitoring can encompass many things such as incidents, near misses, system failures, well integrity issues, kicks, gas releases and can include workers surveys. A key issue is not just data, but *how the data is analyzed and used*.
Use safety approach that fits your operators. A Safety Case works for responsible operators, but a prescriptive focus might work better for other operators and operations. Either, or a hybrid, of the two systems can work as long as the regulator continues to recognize who you they dealing with, which system they are using, and why, and what it's drawbacks can be in the given situation.
Keep the regulator focused on regulating. Non-regulatory responsibilities, placed on the agency that enforces the law, reduces the ability of the regulators to do their jobs and it increases safety concerns. The responsibility of regulating should be consolidated into a competent agency or body. Non-regulatory responsibilities should be assigned to other agencies or bodies. The regulator needs to make sure it regulates and not operates.
Hold the right people accountable. Operators and the contractors have to have very clear lines of responsibility and accountability and few regulators do enough to influence and oversee contractor behavior. Accountability for the regulator includes eliminating regulatory gaps and overlaps where possible, and understand shared responsibilities.
Require a blowout contingency plan. A reviewed and approved blowout contingency plan that is appropriate for the location and well conditions is needed.
Develop an international database and international standards. An international database on incidents with complete, accurate and verifiable data is needed, as is the development of international standards.

Other testimony at the hearings emphasized additional issues:
- Compensate key regulatory staff adequately
- Insulate key regulators from politics
- Keep regulatory staff technically trained
- Have back-up rig for relief well
- Require Arctic-specific BOP training of operators, contractors and inspectors.
- View the Arctic as an international zone

Many of these recommendations are already in place for Alaska,

Comment [D46]: USCG: Agree. This puts a company in a difficult situation by allocating resources before knowing if any benefit will be received. What if an application is not approved?

Comment [D47]: USCG: Isn't this already a requirement post Macondo?

Comment [D48]: USCG: Why limit to the Arctic? Explain difference to why needed.

- a robust inspection program,
- already acquire and analyze performance data for trends,
- already maintain focus on regulating, and
- already have a system in place that insulates regulators from politics.

4.4 National Energy Board of Canada (NEB) Arctic Drilling Review
In response to the disaster in the Gulf of Mexico, the NEB initiated a review of the safety and environmental requirements for offshore drilling in Canada's unique Arctic environment.

Scope of the Arctic Offshore Drilling Review[17]

- Drilling safely while protecting the environment
- Responding effectively when things go wrong
- Lessons learned from other jurisdictions
- Filing Requirements

Key Community Concerns

- Same season relief well capability
- Use of dispersants
- Spill response capability and infrastructure
- Training
- Compensation for Northern residents in the event of a spill
- Wildlife/Environmental Monitors

Community residents said all species, such as beluga, narwhal, char, Arctic cod, polar bear, seal, and walrus, are connected and important to people in the North and they were concerned that a blowout could completely change their way of life

A common thread was found in analyses of major accidents: a neglect of, or even an absence of, processes and procedures to identify, mitigate, or eliminate potential risks. Beneath that deficiency lies an even deeper pattern of organizational cultures that did not put safety first.

Key finding 1: The root cause of most industrial accidents, such as blowouts in offshore drilling, is the lack of a broadly shared safety culture.
Four cultural factors were found in several major industrial accidents.

- tolerance of inadequate systems and resources
- deviation from safety policy becomes normal and accepted
- complacency
- work pressure

Response
1). Any company wishing to drill in the Canadian Arctic must demonstrate that they have a strong safety culture. Filing Requirements include safety culture provisions (and indicators) such as:
• Accountable officer, responsible for the management system
• Annual report on performance of the management system

[17] http://www.neb-one.gc.ca/clf-nsi/rthnb/pplctnsbfrthnb/rctcffshrdrllngrvw/rctcffshrdrllngrvw-eng.html

• Policy and process for internal reporting of hazards

Key finding 2: Reporting and Availability of Information: The NEB's regulatory regime provides the tools required to protect the safety of Northerners and workers, and protect the Arctic environment.

Response

2). Applicants should agree in writing to make public their:
• Safety Plans;
• Contingency Plans;
• Emergency Response Plans (if such plans exist separately from other Contingency Plans); and
• Environmental Protection Plans.

Key Finding 3: Reaffirmed the Canadian Same Season Relief Well Requirement:

Response

3). The Board has re-affirmed the NEB Same Season Relief Well policy. A company must demonstrate how they would meet or exceed the intended outcome of a single season relief well policy, i.e., to kill an out-of-control well in the same season in order to minimize harmful impacts on the environment.

Key Finding 4: Effective response capability is essential with industry leading and providing Community training before an application is filed.

Response

4). Industry agrees that they have a key role to play, commencing with Community training before an application is filed.

…[local] people understand that energy is important and there is a need for energy development, but this development cannot occur anywhere at any cost. It must be done the right way.

Filing Requirements

Filing Requirements for future Arctic offshore drilling applications were developed as a result of the Drilling Review and specify the information to be submitted to in support of an offshore drilling application. They require that an applicant must demonstrate that it has complied with applicable legislation and regulatory requirements. The Filing Requirements should be read in association with the Canadian Oil and Gas Operations Act, regulations and guidelines.

Elements of a Filing Requirement
• Context or guidance
  o used as necessary to clarify key filing requirements
• Goal
  o always provided
  o stated as an outcome
  o stated as concisely as possible
• Filing Requirement
  o describes documents or information to be filed with the Board

4.5 Petroleum Safety Authority Report--The Deepwater Horizon accident—assessment and recommendations for the Norwegian Petroleum Industry

Comment [D49]: What is end-goal of publicizing these plans? Public posting can create complications & vulnerabilities. Would need explanation of how benefit outweighs risk.

Comment [D50]: USCG: This puts a company in a difficult situation by allocating resources before knowing if any benefit will be received. What if an application is not approved?

Comment [D51]: USCG: This puts a company in a difficult situation by allocating resources before knowing if any benefit will be received. What if an application is not approved?

The Petroleum Safety Authority of Norway (PSA) commissioned a report, "*The Deepwater Horizon accident: Causes, learning points and recommendations for the Norwegian continental shelf*", and established a project team to look at improvement opportunities from lessons learned after the Deepwater Horizon incident. This team developed a study "*The Deepwater Horizon accident—assessment and recommendations for the Norwegian Petroleum Industry*." [18]

The PSA report indicates that the Deepwater Horizon accident is a wake-up call to the Norwegian petroleum sector. PSA concluded that the accident must lead to big improvements in managing major accident risk, and that safety culture is lacking throughout the industry (PSA, 2011).

PSA concluded the Deepwater Horizon accident demonstrates the need for improved risk management and processes which lead to more **robust** solutions--ones with built-in safety margins–a degree of resiliency–which enables the operator to handle human and technical error, operational non-conformities, unexpected conditions, the pressure of events, etc. Robust solutions also contribute to the effective identification and management of hazardous conditions, and to ensuring that sufficient time is available to bring such conditions under control. The need for robust solutions applies to technology, capacity, expertise, organization and management in every phase (PSA, 2011).

The Deepwater Horizon accident raises serious questions about the integrity, modernity and efficiency of government regulation, monitoring and influence. That confirms the need for the PSA, on a continuous basis, to continue evaluating and improving the way it seeks to influence safety in the petroleum industry, and the effect of such an influence.

From their study of the Deepwater Horizon accident, PSA came up with 4 Priorities areas:
• Managements role in risk management;
• Barrier management;
• Group/Individual risk (occupational noise etc,); and
• Prevention of harm to external environment

Two main issues identified for PSA from the Deepwater Horizon accident that are most relevant for HSE Management Systems are:

- **Barrier management**: *Industry is responsible for Barrier Management and Well Monitoring*. PSA examined the integrity of 1745 wells of all types and their maintenance—25% had only one barrier and some had two barriers but they were completely deteriorated. This called for immediate action on the part of the operator.
- **Management's role in managing major risk**: *PSA needs information on risks and development of risks in the industry.*

The Deepwater Horizon accident reaffirms the need for the PSA and the industry to continue giving high priority to the work of improving barrier management, and ensuring that this commitment covers all types of barrier elements.

Comment [D52]: USCG: How was this determined from DWH accident? Please provide more derived statement/example how this was drawn.

Comment [D53]: USCG: Agree. Industry must comply with many different regulations from a host of different gov't agencies that all have differing political agendas. Makes for difficult regulatory climate to work in.

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[18] The Deepwater Horizon accident—assessment and recommendations of the Norwegian Petroleum Industry http://www.ptil.no/getfile.php/PDF/DwH_PSA_summary.pdf

Given recommendations made in the wake of the Deepwater Horizon accident, PSA is looking at *major risk* with the use of risk analysis processes and tools. They use and are developing risk analysis processes and tools related to

- the well planning phase (well design and drilling plan)
- the need for better handling of changes to the drilling plan during the operational phase.

In Norway there are 3 legs to safe operations--labor, industry, and the regulator. All have duties and responsibilities. OLF is the labor organization and wrote a report on the Deepwater Horizon and published it June 6, 2012 "Summary Report--Deepwater Horizon: Lessons Learned and Followup." A Tripartite Regulatory Safety Forum is organized every year with all three parties including many representatives to discuss all of these issues.

PSA feels that there has been a positive change in Norway's oversight of offshore oil and gas activities with more focus on major accident risk.

4.6 BSEE Historic Accident Investigations

In a BSEE analysis of 1000 Accident Investigations in the U.S. Outer Continental Shelf (PAME 2013a, p. 21), failure in addressing at least one of these safety management elements was found as a contributing/root cause in each of the 1000 incidents evaluated.

- Hazard Analysis
- Operating Procedures
- Quality Assurance and Mechanical Integrity
- Management of Change

4.7 Department of Interior Assessment of Shell 2012 Arctic Drilling Program, 2013

Recommendations

Industry Operations

- All phases of an offshore Arctic program – including preparations, drilling, maritime and emergency response operations – must be integrated and subject to strong operator management and government oversight.
- Arctic offshore operations must be well-planned, fully ready and have clear objectives in advance of the drilling season. "There should be no loose ends or unnecessary improvisation with critical equipment, assets or drilling plans once operations are scheduled to begin."
- Operators must maintain strong, direct management and oversight of their contractors.
- Operators must tailor their management and oversight programs to Arctic conditions, and the programs must cover preparations in advance of the drilling season and maritime operations as well in-theater drilling operations.
- Operators must understand and plan for the variability and challenges of Alaskan conditions. Reliable weather and ice forecasting play a significant role in ensuring safe operations offshore Alaska, including but not limited to the Arctic.
- Respect for and coordination with local communities. It is an operator's safety and environmental performance that is the ultimate measure of how well and responsibly the company works with North Slope communities and Alaska Natives.

Government Oversight

Comment [D54]: USCG: "Fully ready" for what? Please define further.

- Continued strong coordination across government agencies is essential in the permitting and oversight process.
- Industry and government must develop an Arctic-specific model for offshore oil and gas exploration in Alaska. Industry and government need to continue to develop and refine standards and practices that are specific to the unique and challenging conditions associated with offshore oil and gas exploration

HSE Management Systems Findings

Theme: Systems Safety

Low Probability High Risk events
Major disasters such as the Deepwater Horizon incident are Low Probability High Risk events. These are rare and significant accidents that involve multiple workers or the public and often have far reaching environmental effects. They typically have complex causality related to unique system technology and/or design.

Systems (or Process) Safety
Systems Safety is related to complex systems or processes with many interactions and interdependencies.

- Cannot be adequately dealt with using outcome-based indicators because of the rarity of the outcome.
- Cannot be adequately dealt with using occupational safety statistics.
- Managing complex systems require a holistic approach using leading indicators that show how well the processes or systems are functioning.
- Requires access to all relevant data.
- Requires the ability to assess complex interactions.

Balance or Tradeoffs
Systems Safety involves tradeoffs that start with the well design and go through to well-completion. There are many uncertainties associated with the construction of a well, in particular, exploratory wells, such as geology, weather, well construction materials, and uncertainties in the way people behave when confronted with different situations. There are systems safety and efficiency trade-offs that have to made to achieve adequate margins of safety. Appropriate margins of safety need to be developed to deal with those uncertainties.

Challenges

The problem with Low Probability Events is very few experience them--those that did are either dead or retired.

- Ignorance.
- Arrogance.
- Complacency.
- Systems Safety measures and techniques are far more complex and expensive than occupational safety approach.
- It is hard to convince shareholders to spend the funds for preventing low probability events.

Comment [D55]: USCG: Are these commonly defined HSE words? Consider replacement with lack-of-knowledge or unawareness, and overconfidence?

- Communication between operator and contractors is complex and there is limited sharing of data.
- Not taught to engineering students
- Not many engineering professors who have real experience
- Declining Budgets.
- Workforce Changes.
- Fraud.
- Short Memories: It is hard to change the mindset of the community without "Pinnacle Event."

Comment [D56]: Systems Safety?

Process versus Implementation

Implementation elements were factors in many accidents including the lack of communications, documentation and document control; operational control; management of change; and lack of adequate training.

A common problem, is that a process is adopted but not implemented

- The fundamentals of the system or program are not as important as *how* they are done.
- The degree of implementation of the process and degree of focus to assuring quality is what is important.
- The underpinning culture that supports that process is a key factor.

Theme: Risk Management

If there is no resiliency in the system, then there is little likelihood of being successful

Safety Margin Management establishes margins of safety in the design phase.

Bow-Tie Risk Analysis allows a better assessment to be made of the ability to manage the overall risk.

Monitor Risk by monitoring changes in risk, allows decisions to be made to proceed or not proceed with the operation or activity. It changes the probability part of the risk equation.

Additional instrumentation reduces reliance on indirect measures and lowers risk.

Failure Modes & Effects Analysis assesses the ability to monitor and to check risk levels and margins. This can be factored into a Bow-Tie analysis, where risk levels and margins become much more evident and help in the overall risk evaluation.

PSA is looking at *major risk* with the use of risk analysis techniques. They use and are developing risk analysis processes and tools related to

- the well planning phase (well design and drilling plan)
- the need for better handling of changes to the drilling plan during the operational phase.

The Arctic Offshore

What is different in operations in the Arctic (Δ Arctic) and what increase in risk is associated with that difference?

Challenges

- A basic problem dealing with the risk of low-probability, high-consequence events is convincing the shareholders to spend the money to prevent them.
- The complex structure of the offshore oil and gas industry and the divisions of technical expertise impacts the ability to perform and maintain an integrated assessment of the margins of safety.
- Arctic Amplification of uncertainties, complexity, hazards, consequences, and overall risk.

Δ Arctic = ↑ Risk?

Risk of system integrity issues leading to accidental release (pipelines and drilling installations) as a result of:

- **↑ Probability**
- **↑ Risk**

↑ Probability

- environmental effects on personnel
- communication challenges
- timing/seasonal pressures
- ice and icing + temperatures result in unique design considerations
  - equipment and instrumentation
  - scouring
  - permafrost trapping gas
  - leak detection
  - burying of pipelines
  - cementing

↑ Consequence

- efficacy of response
- environmental consequences/sensitivities
- lack of infrastructure
- economic effects of limiting future activities
- social acceptability of impacts on previously undeveloped areas

Theme: Guidelines, Standards and Regulations

Company, industry and regulator rules are rarely adequate because complex systems rarely exactly repeats a previous accident, therefore levels of detail are invariably inadequate to promulgate effective rules.

Attempts to provide systems safety by exhaustive rules lead to “affirmative defense” mentality

- Compliance with rules constitutes defensible action whether or not the system was safe
- Limits corporate and personal liability
- Psychology infects engineers, designers, workers, and regulators

The focus is on what governments and existing organizations like the IRF or new ones can do to improve safety and the environment. And recommendation on ways to create incentives for management systems and safety culture improvement.

Common Standards

- The wide diversity of operators as in the Gulf of Mexico makes it hard to standardize.

- If just the majors operate in the Arctic, there may be a reasonable chance of success in getting them together with the regulator and coming up with some agreed standards and practices.
- There are only 5 possible Arctic nations with offshore oil and gas activities, which also favors harmonization of standards or practices.
- Canada enforces standards that the operator has committed to applying in its approved plans, or where a standard has been incorporated by reference into a regulation.
- The US incorporates many industry standards in regulations by reference.
- Norway suggests standards and consents to standards that equal or exceed them.
- Russia and Norway are implementing new ISO standards in the Barents Sea (Barents 2020).
- Greenland has adopted and suggests the use of NORSOK standards.

The Inuit Circumpolar Council Declaration on Resources says that international standards setting bodies must seek secure direct and meaningful input from Inuit. The Arctic Council maybe the appropriate place to raise this again.

Theme: Regulatory Approach

Prescriptive and Performance-based

The balance between prescriptive/performance based regulation will shift as operations move into the Arctic. There will be a greater reliance on the “safety case approach” as operations move north. There will be a greater reliance on goal-setting and performance simply because of the lack of experience in the Arctic offshore.

A Performance-Based, or Goal-Setting, Regulatory Approach places the responsibility and accountability on the operator. It is the favored approach for the Arctic offshore because there is too little experience to formulate a comprehensive prescriptive system and also because it allows flexibility to accommodate and incorporate possible rapid development of new technologies and practices.

- Prescriptive systems require an experience of activities to build a detailed understanding of all of the issues but the is lack of experience in the Arctic offshore to draw on for developing a comprehensive prescriptive regime.
- Prescriptive regulations for operations can limit the approaches and technologies best available to do the work safely in any given situation
- Performance-based (i.e. safety-case, outcome-based) regulations allow for innovations and timely use of better and safer new techniques and technology
- Performance-based systems place the responsibility and accountability completely on the operator.
- Prescriptive regulations may lead to an “affirmative defense” in an accident

Inspectors Role

- Having a presence on the rig does not provide much insight beyond occupational safety performance.

- From a systems safety perspective it is not as important to have an inspector on the rig as regulators looking at what is going in the well, which is critically important.
- Access to well and drilling data and the understanding of that data may be more important than an inspector being on the rig itself.

Risk-Based Regulation
In Canada, Norway, and Greenland, enforcement is based on the Continuous Improvement Cycle. This is a Tool for describing “risk-wise’, how a company is doing. Companies must submit regular reports on development of risk indicators for incidents, accidents, release of gas etc.,

Challenges
There are challenges for the regulator in implementing management system frameworks.
• Distinctly different set of skills required for regulatory staff
• More time consuming for staff
• Data is the driver
• Varying maturity level across regulated organizations

Theme: Lessons Learned

Complacency is the biggest threat to safety and everyone really needs to be aware of how to design the processes to fight against that every day.

- Typically, systems technology and applications are pushed until an accident occurs
- Investigations to determine cause and avoid repeating have a tendency to focus on identifying **the** direct cause.
- Time frames vary between major accidents within an industry or process--fifty years (and counting) for U.S. Nuclear submarines; two years for the U.S. Space Shuttle program; and less than eight months between the Montara and Macondo well blowouts.

Learning and Teaching

- Teaching of systems safety in engineering schools is rare
- Guidance to operators on expectations is a teaching and learning experience
- There is an education and communication aspect to dealing especially with small and mid-sized companies to help show them how some of their own elements fit within the HSE expectations of the regulator.

Lessons learned should not all be from major accidents (lagging indicators) or worst-case scenarios, but should include trend analysis of performance using leading indicators such as near-misses, results of audits, worker questionnaires, records of safety meetings, and other documents.

Challenges

- Complacency
- Change is hard. There is often a lag in adoption of corrective measures.
- Learning peaks, and then erodes with time
    - Memories and personnel change

- Perception that changing technology obviates experience
- Hubris builds

Theme: Authority and Accountability/Responsibility

Responsibility: A duty, obligation, or burden. The leadership is responsible for safety.

The Operator is responsible

- The operating company clearly has to have the overall responsibility for integrating the safety assessment.
- For systems safety, the operator is the only one who has the whole picture and access to all information available to make that safety assessment.

Industry is responsible for Barrier Management and Well Monitoring. The regulator needs information on risks and development of risks in the industry.

The operator is responsible for safe operations that do not harm the environment, and they are responsible for their Safety Culture and their HSE Management System.

The complex managerial structure of Arctic frontier operations makes integrated systems safety harder to achieve.

Affirmative Defense, claims no liability if rules were followed or plan was approved—putting the responsibility for safety and environmental protection on the regulator.

Aviation Industry model

- The responsibility for safety is in a general management safety organization who then reports independently to the General Manager.
- Individuals who are responsible for the schedule and delivery do not have to deal with the conflicting pressures.
- Mechanics are trained to have authority and accountability from the very beginning--if they are not willing to sign off on it, then they do not have to worry about being fired or reassigned.

U.S. Navy system

- The minute the Captain takes command they are responsible for everything on the vessel.
- If a ship goes aground, the commander is relived.
- The knowledge and understanding of the accountability pushes the behavior of those who command.
- It forces them to make immediate assessments of not only the physical condition of the vessels, but also capabilities and limitations of equipment.

Nuclear Industry

-

Incentives

- Having people with authority actually signing certifications, management systems, etc., and accepting responsibility and accountability has value.
- Having personal accountability and refining that accountability through incentive programs and other factors is very important to motivating the behavior that a company wants.
- Accountability has to go through everyone who has potential to impact safety—from the drilling engineer to the tool pusher, to the mechanic, and all contractors.

Incentives for Safety Culture
- financial incentives and bonuses
- peer-pressure
- Soft signals, such as rewarding a “Stop,” must be better implemented through the management system.

“Pay for Performance” incentives do not address safety.

Occupational safety indicators and performance appraisals are outcome-based, such as no-loss-work days and no accidents days. Because major accidents are rare outcomes, there is a need for the incentives to focus on the “process,” or how the system is functioning.

Contractors
Operators and the contractors have to have very clear lines of responsibility and accountability. Bridging Agreements or Documents between contractors and the operators often serve this purpose and layout the operators requirements of the contractors.

Few regulators do enough to influence and oversee contractor behavior.

Regulator
Accountability for the regulator includes eliminating regulatory gaps and overlaps where possible and understanding shared responsibilities with other regulators.

It is the operator’s responsibility to design and operate a well, and the regulators to review, audit, inspect, reject, consent, accept or approve the system design and operation—this includes the operators HSE Management System.

Challenges
- Standard communication processes do not necessarily transfer to the Arctic.
- The regulator needs to make sure it regulates and not operates, such as by dictating design.
- Corporations sometimes subvert safety culture
  - Using volunteers to get around refusal of unsafe work
  - People attain status and receive compensation for doing unsafe work
  - Authority and accountability are skewed toward getting the job done
- The petroleum industry is structured differently than the aviation or naval submarine industries.

- The petroleum industry has many layers in their operations, including contractors, subcontractors and sub-subcontractors.
- Cultural differences exist in different high-hazard operations.

Audit and Review

Several HSE elements dealing with review and monitoring have been identified as common to many industrial accidents, they include:

- deficient inspections and monitoring;
- inadequate corrective and preventive actions to address identified deficiencies;
- poor records management
- poor internal audits, and
- lack of adequate management review.

PSA Audits and Verification. System Audits are conducted on a risk-based prioritization schedule. Conclusions address improvement opportunities in the main systems and management systems.

Norway requires an Acknowledgement of Compliance (AoC). The AoC is not an Approval. The AoC's cover all types of activity and may be required from the Rig Owner to the Drilling Contractor. The Operator must do a Gap Analysis.
The Gap Analysis is
• Risk-Based
• Identifies Non-Conformities
• Institutes Dialog for improvement.
• Uses a Near-Miss inventory for trends.

Major Industry operators use an audit process that has multiple levels of assurance. For example, Shell Gulf of Mexico has:

- Corporate level – audits against company standards/policies, reports to Corporate Business Assurance Committee (BAC).
- Business level -– audits against local standards /policies, including regulatory requirements.
- Local level - self-assessment against local standards /work procedures.

Challenges
Audit guidance is needed for countries adopting more performance-based oversight, such as audit techniques, use of gradational systems and the Pass-Fail approach and how they contribute to continuous improvement and enforcement.

Reporting

Regular reports on the performance of the management system from the operator's responsible authority are essential for auditing and assessing the effectiveness of the system and it's continuous improvement.

The operator needs to have a policy and process for internal reporting of hazards.

In Canada applicants agree in writing to make public their:

- Safety Plans;
- Contingency Plans;
- Emergency Response Plans (if such plans exist separately from other Contingency Plans); and
- Environmental Protection Plans.

Comment [D57]: USCG: What is end-goal of publicizing these plans? Public posting can create complications & vulnerabilities. Would need explanation of how benefit outweighs risk.

Challenges

- Reports on the management systems performance is inadequate or based on inadequate indicators or metrics.
- Processes of internal reporting of hazards are inadequate or not implemented.
- Near-miss process safety incidents often involve proprietary geological information or technology or techniques, and absent an accident, their details are not shared widely.
- Near-miss incident reporting requirements are not uniform nor well-defined by Arctic regulators.
- The proprietary nature of some near-miss incident data conflicts with transparency of the decisions made by the regulator.

Continuous Improvement

Included as one of the four principles of the U.S. Safety and Environmental Management System requirement: "continuous improvement in the offshore industry's safety and environmental records;"

Elements critical to ensuring continual improvement within the system include:

- Inspection;
- Measurement and Monitoring;
- Corrective and Preventive Actions;
- Records Management;
- Internal Audits, and
- Implementation of follow-up measures

Continuous improvement of offshore performance requires actions from and cooperation between industry and regulators.

In the Arctic offshore, where there are many uncertainties and little experience to draw from, it is imperative that performance is improved on a continual basis by continually monitoring, assessing, and managing risk in these complex frontier operations.

For Industry continuous improvement should be integrated throughout the whole process--from Design to Decommissioning and include

- Risk Assessments and analysis

- Audits, reviews,
- Follow-up measures

For the Regulator continuous improvement is accomplished through

- Risk Based regulation
- Life Cycle Management
- Monitoring
- Inspections
- Enforcement

Comment [D58]: USCG: This is an industry function.

The process of continuous improvement is driven by data and the analysis of performance trends from that data.

Challenges
Cooperation between Regulator and Operator
Data is not always available or collected
Data is not analyzed for indentifying opportunities for improvement

Safety Culture

Safety Culture relates to the Operator, but regulators have an important role in promoting a positive safety culture.

Safety culture and disasters

- 14 out of 17 disasters contained cultural causes
  - Tolerance of inadequate systems and resources (identified 10 times)
  - Normalization of deviance, (identified 9 times)
  - Complacency, (identified 8 times)
  - Work pressure/ cost (identified 4 times)

Definitions of Safety Culture

There are several similar definitions of Safety Culture. Definitions heard at the Workshop or made by Arctic States include:

"*Safety culture is the product of individual and group values, attitudes, competencies and patterns of behaviour that determine the commitment to, and the style and proficiency of an organization's health and safety programmes*." (Advisory Committee for Safety in Nuclear Installations, 1993; p. 23)

Safety Culture is *"the shared values, norms and activities used by an organization to manage risk."*

Safety culture is industry's leadership commitment and involvement in implementation of safety.

The BSEE defines safety culture as the core values and behaviors resulting from a collective commitment by leaders and individuals to emphasize safety, over competing goals, to ensure protection of people and the environment.

Safety cultures are hard to create but constitute irreplaceable avenues to systems safety.

Culture: the shared values that exist within a particular organization

Culture determines the extent to which you live your systems.

Culture is what you do when no one tells you what to do.

Other statements on Safety Culture from the workshop:

A company never "gets" a safety culture. It is a continuous process of improvement and always needs work. "It's not a destination, it's a journey."

An effective safety culture establishes the priorities for safety vs cost & schedule trades

Safety and influencing safety are bigger than the industry, but safety culture is not.

Attributes of a positive Safety Culture

- Safety is part of everything
- Consistent leadership ~~behaviours~~behaviors
- Open and honest communication
- Common goals
- People are professional and learning is valued
- Standardized practices
- Consistent rules which apply to all parties
- Standardized metrics
- Rigorous assurance processes in place

A characteristic of a positive safety culture is a pattern of thinking, feeling, and behaving that emphasizes safety, particularly in goal conflict situations (*e.g*., production, schedule, and the cost of the effort versus safety).

Effective Safety Culture

- An effective safety culture establishes the priorities for safety vs cost & schedule tradeoffs
- Tradeoffs need to be conducted from drilling engineer to tool pusher and from preparation to bid on lease to completion of well
- Safety priorities and expectations must be clearly stated and communicated to all and management behavior and communication must be consistent at all levels and all times
- All actions by management must be consistent such as assignments, promotions, compensation etc
- Starts with CEO priorities and compensation incentives and goes through all levels of management

Six Dimensions of Safety Culture (Mark Fleming, St. Mary's, Halifax)

Leadership for safety is clear:

- Managers take every opportunity to demonstrate their commitment to safety.
- Leaders across the organization are actively involved in safety and act as role models for others.
- Leadership skills are actively developed

Safety is integrated into everything:

- Safety is an approach to doing things rather than an activity; therefore it is part of all activities.
- An operation or task is only a success if completed safely.
- Factors that influence performance, such as motivation, are acknowledged to influence safety outcomes

Accountability for safety is clear:

- There are clear lines of authority for safety
- Everyone is aware of their specific tasks and responsibilities.
- Everyone feels ownership for safety within their span of control.
- The independent and distinct role of the regulator is understood and respected

Resilience: People should not "tolerate inadequate systems."

- In a positive safety culture, employees are encouraged to develop a questioning attitude.
- Employees are supported and rewarded for raising safety concerns or challenging management decisions
- Diverse workforce
- Teams contain team members with different backgrounds and skills

Safety is learning driven:

- Striving for continuous improvement.
- Learning drives improvement.
- Actively seeking out lessons from operational experience and conducting self assessments.
- Seeking to understand both failure and success in order to improve.

An effective safety culture supports institutions that can materially contribute to systems safety such as:

- Independent Technical Authorities
- Real Time Operations Centers

Indicators and Safety Culture

- An operator depends on indicators for improvement and should include assessments of Safety Culture using things like safety records and other indicators.
- Information needs of the government to gauge an operator's qualifications or performance is not always the same as industry's.

- Government needs to know problems and a focus on near-term trends so that the problems can be addressed.
- The use of these types of indicators also helps the safety authorities by giving a picture of the quality of the operator and contractors.

Audits and Reviews

Audits for compliance of Safety Culture can include the way a company addressed known inadequacy of machinery, infrastructure, or resources by reviewing maintenance logs and concerns raised at safety meetings, etc., and the follow-up on these issues by the operator.

Contractors Safety Culture and HSE

- In the US (Norway, Canada, and Greenland), the government sets out the expectation that the operator is responsible for ensuring that all of the contractors meet the requirements.
- The U.S. SEMS requires a document (Bridging Agreement) that includes Safety Culture be signed between the operator and contractor.
- The further the activity is away from the operator, down into the subcontractors and sub-subcontractors level, the harder it is to audit and ensure contractors have a positive safety culture.
- Some contractors work simultaneously for different companies that have different standards.

Safety Culture can be treated the same way as HSE Management Systems, in that it is up to each company to define their system and process, and verify that they are complying with the regulations and meeting their own requirements defined in that system and process. The fundamentals of the Safety Culture system or process are not as important as *how* they are done. The degree of implementation of the process is what is important. This equally applies to the overall management system submitted by an operator.

The process is important, but it is the degree to which it is implemented that matters and the degree of focus to assuring the quality of the process.

Challenges

- Tolerance of inadequate systems and resources
- Normalization of deviance
- Complacency
- Work pressure/cost
- Poor metrics and indicators of safety culture
- It is hard to develop and improve a safety culture in a prescriptive, compliance mentality environment
- We need to be more critical about safety culture and do not automatically accept it as an undefined cause of all accidents—as the modern version of last century's "act of god" finding for accidents.

Partnerships

Because an HSE Management System, including the elements of a safety culture, is set by the operator with guidance and enforcement from the regulator, a degree of cooperation and communication is necessary.

Openness, Partnership, Cooperation

- Meaningful and necessary interaction between Government and Industry (and labor) requires openness.
- Regulators can be both independent *and* supportive, much depends on whether they are there to catch and punish or to help foster a positive safety culture and system improvements.

Two US initiatives are promising

- the Center for Offshore Safety (API)
- the Department of Interior SEMS approach, which is based on caring more about the safety outcome than about the individual infractions, less about punishing and more about encouraging.

One of the four principal SEMS objectives in the U.S. is, collaborate with industry in efforts that promote the public interests of offshore worker safety and environmental protection.

Challenges

- There is an apparent conflict in the regulator having independence and establishing a three-way partnership between management, government, and labor.
- It requires regulators to be competent. But industry gets most competent people.
- This is more of a challenge for industry to be open and cooperative.
- This openness and cooperation are culturally easier to achieve in Norway than elsewhere.

Proprietary Data and Near Miss Reporting

Requiring operators to share information on "near misses" will be critical in the Arctic, where experience is essentially non-existent. Learning what almost went wrong is needed for risk analysis and can help others build safeguards into their operations.

To foster collective learning, and to regulate, near miss data is needed as leading indicators to reveal trends. Not just accident and worst-case-scenarios.

Oil and gas operations have reduced incident frequency. But numbers of blowouts are so rare as to not be a statistically valid sample to establish trends in safety performance.

The International Regulators Forum had an initiative for Common International Incident Reporting Requirements, and may be a logical place to develop near-miss reporting definitions and requirements.

OGP maintains an anonymous database of near-misses that tracks occupational safety related incidents and ~~are~~ is working to compile well-control incident database.

The BSEE has investigated 1000 accidents as of January 2006 but the regulations do not require reporting of near-misses. There is work underway in industry through the Center for Offshore Safety (COS) to determine trends from near-misses. It was suggested U.S. Federal Aviation Administration-type reporting could serve as a possible template for reporting near-misses.

Challenges
This data is not usually public.
There is a hesitation in industry to share data, other than occupational safety data.
Transparency as a regulator is difficult when critical, safety related, data is held proprietary.

Capping and Containment

Capping and Containment is not covered in the Preparedness and Response Task Force nor in EPPR.

Capping and Containment equipment or processes are not, at present, required by regulation in the Arctic. In the U.S. Arctic, capping and containment requirements are currently included in the operators approved Exploration Plan.

Arctic Offshore Oil and Gas Guidelines

At the conclusion of the June 10, 2012 PAME Health Safety and Environmental Management workshop, it was decided that:

- The AOOGG 2009 has ample guidance for HSE Management Systems and Best Practices for offshore oil and gas operations for preventing a major systems failure accident in the Arctic.

HSE Management Systems Recommendations

Management Systems

- The focus of the regulator should be on prescribing processes and establishing objectives, as opposed to prescribing technological and design considerations.
- Establish standards for what the regulator expects that everyone must meet.
- Establish criteria for what expectation the regulator has that the operator and contractors will be able to meet the standards.
- Establish what the expected standards are for competency.
- Industry and regulators should foster an effective safety culture though consistent training, adherence to principles of human factors, system safety, and continued measurement through leading indicators.
- Require operators to develop a comprehensive 'safety case' as part of their exploration and production plans' for certain high-risk areas including the Arctic.

- Develop more detailed requirements for incident reporting and data concerning offshore incidents and 'near misses' and make it publicly available.
- Assign individual civil and criminal liability for corporate leaders for certifying their management systems.
- Consider establishing an independent "Tech Authority" that is separate and independent from operator/regulator that focus on reviewing and approving any variances from procedures or specifications.
- Address the need to drive the "critical view" of the HSE Management System to the lower levels, down the contractor/subcontractor chain, by developing clear, consistent procedures

Comment [D59]: USCG: What is end-goal of publicizing these plans? Public posting can create complications & vulnerabilities. Would need explanation of how benefit outweighs risk.

Comment [D60]: USCG: What happens to the corporate leader when a worker, on the drill floor, misses a tell tale and the well blows out? Perhaps add something that draws on punishing those who sign off on a management system found to be inadequate.

Managing Risk

[Some factors on how companies manage risk are within government's control. These recommendations are meant to be "influencive"]

Regulators and industry need not just look at occupational accident statistics, but should focus on assessing *major risk* with the use of risk analysis techniques.

Increased rigor in oversight and redundancies are required due to increased risks, un-tested equipment, challenges with operation of remote operated vehicles.

Risk in the Arctic

Δ Arctic = ↑ Risk

Necessitates:

- Increased oversight
- Increased redundancies
- Special focus on:
  - Implementation, ongoing review and corrective action processes included in safety management systems
  - Safety Culture
  - Certain HSE elements

- Require Safety Margin Management--margins of safety are established in the design phase.
- Use Bow-Tie Risk Analysis--a better assessment can be made of the ability to manage the overall risk.
- Require Monitoring of Risk by monitoring changes in risk, a decision can be made to proceed or not proceed with the operation or activity. It changes the probability part of the risk equation.
- Require Additional Instrumentation—do not rely on indirect measures.
- Consider use of Failure Modes & Effects Analysis which assesses the ability to monitor and to check risk levels and margins. This can be factored into a Bow-Tie analysis, where risk levels and margins become much more evident and help in the overall risk evaluation.
- The multi-lingual ISO 31,000 High Level Risk Management Guidelines should be used for common terminology and communications.
- Require integrated risk assessment and analysis for the whole operation

Auditing/Review

Develop and share HSE Management Systems performance indicators.

Share trend analyses to enhance the assessment of major risk in the industry.

Conduct audits on a risk-based prioritization schedule and use the results to address improvement opportunities in the management system and safety culture.

Consider establishing an independent Safety Institute that develops and enforces industry standards.

Real Time Monitoring

Require real time operations centers. Government regulators should be involved in real-time monitoring at major points in the operations—such as negative pressure tests and other critical operations. The regulator should be knowledgeable and trained in the operations being monitored.

Accountability

Require operators to assign and identify persons responsible and accountable at all times for critical decision-making processes including the HSE Management System.

Assign individual civil and criminal liability for corporate leaders for certifying their management systems.

Comment [D61]: USCG: What happens to the corporate leader when a worker, on the drill floor, misses a tell tale and the well blows out? Perhaps add something that draws on punishing those who sign off on a management system found to be inadequate.

Require people with authority to accept responsibility and accountability by signing off on certifications, management systems, etc.

Require contractors to have an HSE Management Systems or clear lines of responsibility defined in a bridging document.

Qualifications

The case-by-case approach on evaluating an operators qualifications and performance used in other parts of the offshore should be replaced with a stated expectation and standards that everyone must meet. The Arctic is different—only companies that meet performance, financial, and technical qualifications should be allowed to drill.

The safety record of the whole company should be an indicator of performance.

Decisions on who qualifies for a lease should factor in the financial capabilities to pay for an effective response.

Comment [D62]: USCG: This is problematic. Companies often partner (form joint ventures) when leasing and exploring.

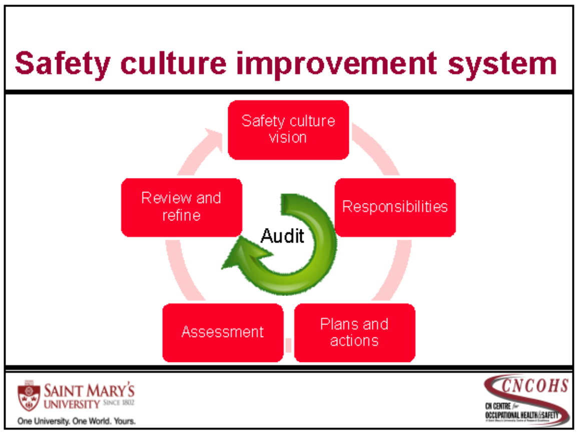
Reporting

Require the use and mandatory reporting of near-miss data as an indicator of safety culture.

Develop protection for whistleblowers

Safety Culture

"Safety Culture: The oil and gas industry must adopt a "culture of safety" as a collective responsibility with a focused commitment to constant improvement and zero failure rate and set up mechanisms to implement it.



Model of a Safety Culture Improvement System, from Mark Fleming, St. Mary's University, Halifax

Disaster prevention

- Do not think of Safety Culture as an "Optional Extra"
- Do not deceive yourself
- Adopt a systematic approach

Define Safety Culture

- ➢ An organization should pick a definition that fits their culture and stick with it to avoid ambiguity, or use of it in an ambiguous way.
- ➢ To improve safety culture it has to be defined and stated what they mean by safety culture in their organization.
- ➢ Other things may be done in the organization to improve safety, but if they fall outside of the definition of safety culture then they are not part of safety culture.

Rather than defining it as an outcome, find a process for an organization to put in place a consistent policy for safety culture that:

- ➢ Says the organization has a safety culture and defines it,
- ➢ Has a process to support and improve Safety Culture, and
- ➢ Has a solid methodology to actually assess the extent that they are really doing what they say they are doing.

Audits, Assessments and Metrics

Indicators

Indicators used to audit for a positive safety culture could include the way a company addressed known inadequacy of machinery, infrastructure, or resources. NEB reviews maintenance logs and concerns raised at safety meetings, etc., and the follow-up as necessary, noting the differences between occupational and process safety indicators.

Management should review asset integrity and process safety performance metrics on a regular basis

- Sr/Executive Management – Quarterly
- Operations/Line Management – Weekly/Monthly
- Field Supervision – Daily/Weekly

Performance metrics should contain a good mix of leading and lagging indicators

- Leading: alarm rates, PM/CM schedule compliance, overdue MoCs, Near Misses
- Lagging: Hydrocarbon spills, Recordable accidents, fires

Comment [D63]: USCG: What is this?

Incentives for Safety Culture

How to embed a meaningful and sustainable safety culture?
By internally and externally influencing corporate decision-making. Ways to achieve this include:
Incentives and disincentives (Cost, profit, penalties, insurance, loss, performance programs, bonus structures, and non-financial rewards such as promotion and recognition)

- "Pay for Performance" incentives (using lagging indicators) do not address process or systems safety.
- Focus on "process" and how the system is working as a focus on incentives (using leading indicators)
- Use a performance-reward and process-oriented bonus reward basis, where the extent to which the leaders are meeting expectations they set for themselves is rewarded.
- Soft signals, such as rewarding a "Stop", must be better implemented through the management system.
- To incentivize system safety consideration by the shareholders, the profit could be tied to performance, or CEO pay tied to safety.
- New laws with "claw back" provisions, where previous bonuses get pulled back.
- Management could develop and institute "0 and 1" decision factors or "Go/No Go" decision thresholds for major incidents.
- Assign individual civil and criminal liability for corporate leaders for certifying their management systems.

People (Leadership, training, peer pressure, culture)

- Establishing incentives and protections for whistleblowers can influence a positive safety culture.
- Require corporate management to sign off on and be accountable for the management system.
- All actions by management must be consistent (assignments, promotions, compensation etc.)
- Safety priorities and expectations must be clearly stated and communicated to all
- Management behavior and communication must be consistent at all levels and all times

Information (Data analysis, disclosure, comparison, continuous improvement)

The offshore oil and gas industry should focus on process performance (leading) indicators, rather than just outcome-based performance to account for, and avoid, low-probability, high-consequence outcomes.

Regulation (effective, constructive, independent enforcement to assure attention to risk management: accountability)

- Assess and Monitor more robustly.
- Eliminate regulatory complexity.

Inspect, Regulate, Monitor Performance, Improve Performance, and Penalize.

Regulators should be well-compensated professionals and have the flexibility in hiring and retaining professionals that not only have the expertise but also the respect of, and the opportunity to engage with, their industry partners instead of the traditional adversarial inspector check-box inspection mentality.

- Compensate key regulatory staff adequately
- Insulate key regulators from politics
- Keep regulatory staff technically trained
- Ensure adequate/stable resourcing for regulatory oversight and a need for increased competence/independence.
- Establish fees as dedicated source of funding for regulators
- Significantly expand the formal education and training of regulatory personnel engaged in offshore drilling roles.

Comment [D64]: USCG: For a performance based regulatory regime the regulators need to have as much training and experience as the industry personnel and be compensated comparably.

Openness, Partnership, Cooperation

"Paid Informants" an alternative model for interaction between Regulators and Operators:
Government employment of rig workers one day a week to provide the regulator with real-time, first-hand information on safety performance on that rig

- Could provide valuable feedback on how safety is managed, and insight into challenges facing the operation.
- A process to improve meaningful interaction and promote safety culture development

Independent Role Examiner Approach

- A critical feature for non-chartered engineers such as Petroleum Engineers in the United States. Both independent and competent
- Follow the construction of the well, not just the approval at the beginning.
- Independence is guarded very carefully.

Comment [D65]: USCG: What is this? Referring to PE licensing?

Safety Culture Improvement System Mark Fleming St. Mary's University, Halifax

A company never "gets" a safety culture. It is a continuous process of improvement and always needs work.

Safety Culture Vision:
- States the desire to continuously strive to improve the safety culture in pursuit of perfection
- May include a definition of a positive (ideal) safety culture

Responsibilities and Accountability::
- Defines responsibility and accountability for key groups in creating and maintaining a positive safety culture
  - Managers
  - Supervisors
  - Contractor management
  - Non managerial staff
- Presents a safety culture framework

***Plans and Actions*:**
- Review current practices (e.g. using safety culture improvement tool)
- Sets short and long term safety culture improvement objectives
- Specifies processes to promote a positive safety culture
- Links with other aspects of the SMS (e.g. training, incident reporting)

Assessment: The Assessment element should be broken into two main categories.
- Episodic (biannual)
  - Multi method safety culture assessment (e.g. questionnaire, interviews, document review)
- Continuous
  - Safety culture metrics
    - Capturing the markers left by safety culture on daily operations (e.g. the quality of safety reports)

Review and Refine:
- Review
  - Safety culture assessment
  - Audit
  - Other safety performance information (e.g. incident reviews)
  - External (e.g. research, other organisations)
- Refine safety culture management system

Audit: Very similar to other stand-off processes.
- Assessing the implementation of safety culture improvement processes:
  - Compliance with specified plan (e.g. leadership training plan)
- Assessing the effectiveness of the processes
  - Extent to which process met desired objective (e.g. change leader behaviour)

Capping and Containment

The oil and gas industry should have containment technologies immediately available.

Sharing Capping and Containment equipment. Need for sharing and availability. How many facilities do you try to support at a given time? A national regulator issue and their responsibility to let everyone know where this equipment is, and the feasibility and the time it would take going from point A to point B.

Capping or Containment Stack requirements could be made BAST in the Arctic (API RP 17W may be a template). A standard technique that nations would agree on and would be relatively easy in the Arctic, because there are less well head designs to accommodate.

Relief Wells

Require back-up rig for relief well

Establishing standards up front for relief well capability is important due to the planning, cost, and availability of rigs.

Same Season Relief Well policy. A company must demonstrate how they would meet or exceed the intended outcome of a single season relief well policy, i.e., to kill an out-of-control well in the same season in order to minimize harmful impacts on the environment.

Proprietary Data and Near Miss Reporting

Define "near-misses"

Incident/near-miss reporting should be public

Comment [D66]: USCG: What is end-goal of publicizing these plans? Public posting can create complications & vulnerabilities. Would need explanation of how benefit outweighs risk.

Develop Common reporting of near-misses (i.e. IRF's Common International Incident Reporting Requirements initiative).

International Standards

The President's Commission recommended there be one set of standards and requirements in Arctic offshore operations, covering

- design,
- construction,
- transportation,
- installation, and
- removal of offshore structures.

Barents 2020 has compiled and developed common standards for operations in both the Russian and Norwegian Barents sea and this could serve as a model or starting point for a wider discussion.

Develop an international database and international standards. We need an international database on incidents with complete, accurate and verifiable data and we should develop international standards. AOGCC

Global Best Practices: The oil and gas industry should benchmark safety and environmental practice rules against recognized global best practices.

Appendix 2: Arctic Oil and Gas Guidelines, 2009

The Arctic Council Offshore Oil and Gas Guidelines Recommendations for HSE Management Systems

Principle(s)

Continuous improvement (AOOGG p 6)

All parties should continually strive to improve health, environment and safety by identifying the processes, activities and products that need improvement, and implement necessary improvement measures. The process of identifying what can be improved may be based on mappings and results of analyses, investigation of situations of hazard and accident, or near hazards and accidents, handling of non-conformities, experience from internal follow-up or auditing, or experience gained by others.

Safety and Environmental Management (AOOGG p 25)

Two basic regulatory approaches are available for dealing with the safety and environmental aspects of offshore Arctic oil and gas operations. They are: (A) a performance-based system and (B) a prescriptive approach.

(A) In the performance based approach, the regulator sets specific quantifiable goals but does not specify how the operator must meet these goals. This system allows the operator the flexibility to specify how they intend to comply with a regulatory body's mandate that operations be conducted safely and in an environmentally sound manner. There are a variety of approaches available to the operator to meet the intent of this alternative, including the use of technical standards, company guidelines, "safety case" initiatives, or combinations of the above.

(B) The prescriptive approach to regulation is based on a series of specific regulatory requirements, which typically represent minimal expectations on behalf of the regulatory body. This approach can be complemented by a performance-based program. Under the prescriptive system, a regulatory body normally develops requirements addressing all phases of offshore operations. The requirements are typically developed from a series of existing standards, practices, guidelines, and procedures. Compliance with these requirements are normally evaluated by a regulatory body through review and evaluation of a series of plans, permits, and related documents and through a system of field based inspections and evaluations.

Either regulatory approach, performance or prescriptive, can be modified to form a 'hybrid" system of regulation, composed of appropriate elements from both regimes. Such a system of regulation may represent a viable alternative for a regulatory body to consider adopting due to the systems' ease of operation and flexibility.

Today, there has been significant interest by both the offshore oil and gas industry and the various regulatory bodies to adopt, when applicable, appropriate international standards as a component of a regulatory system (performance, prescriptive, or hybrid). Use of these international standards addresses the fact that more often than not, regulators are regulating a global industry and there is value in using global standards wherever practical.

In either approach, before oil and gas activities are approved, regulatory bodies should require the operator to demonstrate financial capacity to carry out all aspects of the operation, including responding to environmental emergencies and decommissioning of facilities. This should also include the proven ability to adequately clean up oil spills.

There are many similarities between the two systems of regulation. An important management tool to assist the operator in meeting the regulatory objectives of either system, eliminating unsafe behavior, and achieving continual improvement in safety and pollution prevention practices is defining and communicating a culture focus on safety and environmental performance to the workforce and ensuring that they are fully motivated to implement it through a management system. This philosophy can also be applied to a hybrid regulatory program. See Annex F.

Management Systems (AOOGG p26)

Proper planning to address the environmental sensitivities of a project and to ensure safety of the work force is essential. Whether required by the regulator or conducted voluntarily within industry, environmental and safety planning should be contained in a formal management system. Often referred to as EMS (Environmental Management System), HSEMS (Health and Safety and Health Environmental Management System) or SEMP (Safety and Environmental Management Program) these systems focus attention on the influences that human behaviour and organization have on accidents. Various types of management system documents have been developed around the world with applicability to the offshore oil and gas industry. These include; American Petroleum Institute (Recommended Practice 75), the International Organization for Standardization (ISO 14000 and 9001 series) and Oil and Gas Producers (OGP) and UNEP/OGP publications.

These systems all have as a common and central feature a cyclic process involving sequential consideration of:

- policy and strategic objectives;
- organization, resources and documentation;
- risk evaluation and risk management;
- planning;
- implementation and monitoring; and
- auditing and review

Each step of the cyclic process requires leadership and commitment by the implementing body and the principal aim of the system is to deliver continual environmental, safety and health performance. This is assessed by periodic audit or review of a management system's performance to ensure that necessary components are in place and that they are effective.

The key elements of a management system can be described as follows:

Policy and Strategic Objectives (AOOGG p26)

The operator's management should define and document its safety and environmental policies and strategic objectives and ensure that these:

- have equal importance with the operator's other policies and objectives;
- are implemented and maintained at all organizational levels;
- are publicly available;
- commit the operator to meet or exceed all relevant regulatory and legislative requirements;
- commit the operator to reduce the risks and hazards to health, safety and the environment (HSE) of its activities, products and services; and
- provide for the setting of safety and environmental objectives that commit the operator to continuous efforts to improve performance

The operator should also take steps to ensure that all contractors engaged in operations are also able to meet the requirements of the operator management system and applicable laws and regulations.

A more detailed and specific list of possible objectives is set out in Annex F.

Organization, Resources and Documentation (AOOGG p27)

Successful management of safety and environmental matters is a line responsibility, requiring the active participation of all levels of management and supervision. This should be reflected in the organizational structure and allocation of resources. The operator should define, document and communicate - with the aid of organizational diagrams where appropriate - the roles, responsibilities, authorities, accountabilities and interrelations necessary to implement the HSEMS and meet regulatory responsibilities. The operator should also stress and encourage individual and collective responsibility for safety and environmental performance to all employees. It should ensure that personnel are properly trained, competent, and have necessary authority and resources to perform their duties effectively.

Evaluation and risk management (AOOGG p27)

The operator should maintain and implement procedures to identify systematically the hazards and potential effects, which may affect or arise from project inception through to decommissioning and disposal. Procedures should be maintained to evaluate (assess) risk and potential effects from identified hazards against screening criteria, taking into account probabilities of occurrence and severity of consequences for:

- People;
- Environment; and
- Assets.

The operator should maintain procedures to select, evaluate and implement measures to reduce risks and effects throughout the project. Risk reduction measures should include both those to prevent incidents (*i.e.* reducing the probability of occurrence) and to mitigate chronic and acute effects (*i.e.* reducing the consequences). In all cases, risks should be reduced to a level deemed as low as reasonably practicable, reflecting amongst other factors, local conditions and circumstances, the balance of costs and benefits and the current state of scientific and technical knowledge.

Risk Assessment and Environmental Risk Analysis (AOOGG p.16)

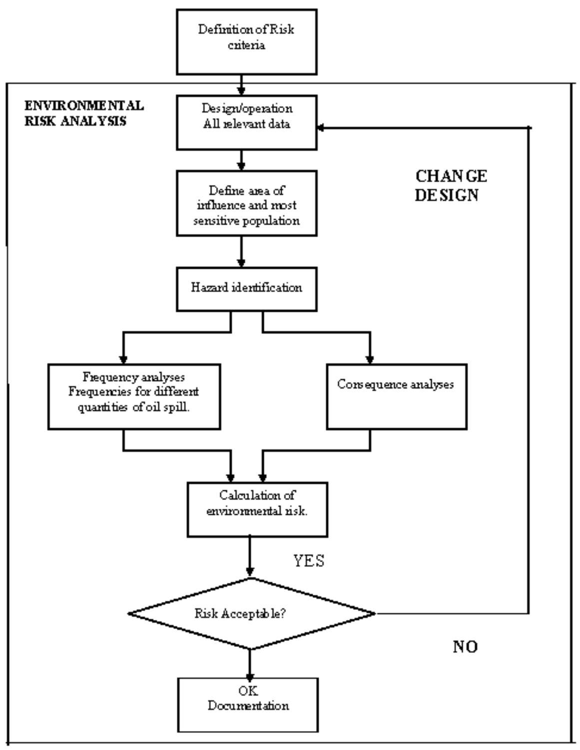
The reason for a risk assessment or analysis is to determine if an action has an acceptable level of risk. Both regulators and industry use the information gathered through an EIA and risk analysis to make decisions on whether a proposed activity or development should go forward as planned, to institute preventative and mitigating measures to reduce risk, or to chose another alternative action.

Prior to carrying out an environmental risk analysis, risk criteria should be defined. The risk criteria should be documented and the regulator and/or operator should update the criteria during the course of operations as appropriate and necessary for enhancing the safety level and as an effort to achieve the objectives defined for the activities. Risk or acceptance criteria must at a minimum incorporate national and international laws and standards. Consultation should also include input from local communities and interested parties for risk criteria analysis. If data is insufficient to define risk criteria, then the risk assessment should also incorporate the precautionary principle as reflected in Principle 15 of the Rio Declaration.

The environmental risk analysis should be initiated as soon as practical to allow time if needed for public consultation. The analysis should be valid for the period of the year the operations will be carried out. If there is uncertainty of the timing of operations, the analysis should be valid for a longer period.

Risk associated with offshore oil and gas activities has two main elements--the risk that an event might happen, such as an oil spill, and the risk that something will be impacted, such as ecologically sensitive areas. A risk assessment should be carried out in order to estimate the risk of an acute oil spill or other event. An environmental risk analysis should be conducted to identify impact sensitivities from an acute spill or event, as well as, spills that result from routine operations, including approved discharge of drilling fluids or cuttings. The analysis of each potentially affected environmental resource should clearly distinguish between the risk of oil spills or other accident and impact severity. The risk of contact in an acute spill does not influence the impact severity. Probabilities related to acute oil spills should be estimated or modeled based on geological studies on resource estimates and distribution, development scenarios, site-specific and regional considerations, exploration and production plans, and historical data. An analysis of response strategies, techniques, and capabilities should be conducted to determine the efficacy and feasibility of oil spill response throughout the year.

The analysis also should identify the need for risk reducing and contingency measures. Requirements stipulated by or in law or regulations, including requirements for risk reducing measures and the operator's safety objectives, should form the basis for defining an acceptable level of risk.



Flow Chart depicting an environmental risk analysis scheme (Annex F AOOGG, 2009, p. 88) (Note that this report suggests using a Bow-Tie Risk Diagram as a supplement or replacement for this flow diagram)

Planning (AOOGG p27)

The operator should maintain, within its overall work program, plans for achieving environmental objectives and performance criteria. These plans should include:

- a clear description of the objectives;
- designation of responsibility for setting and achieving objectives and performance criteria at each relevant function and level of the organisation;
- the means by which they are to be achieved;
- time scales for implementation;
- programs for motivating and encouraging personnel towards a suitable HSE culture;
- mechanisms to provide feedback to personnel on environmental performance;
- processes to recognise good individual and team environmental performance; and
- mechanisms for evaluation and follow-up.

The operator should develop, document and maintain and review plans and procedures for responding to emergencies. These plans and procedures should reflect site-specific characteristics. In order to assess effectiveness of response plans, the operator should maintain procedures to test emergency plans by scenario drills and other suitable means at appropriate intervals. Plans should be revised and updated as necessary in light of experience gained. Plans should be available to the affected communities and the public at large.

Compliance Monitoring, auditing and verification (AOOGG p28)

Compliance monitoring, which include carrying out audits, inspections and verifications, are key activities for the authorities when it comes to following up the petroleum activities in the Arctic. Compliance monitoring may be carried out within a variety of organizational frameworks. For example, the recommendations of the European Parliament and Council provides for minimum criteria for environmental inspections in the European Union (EU).

The regulatory supervision should cover all stages of design, fabrication, installation, operations and removal of offshore installations. It should address all relevant parts of the operating company's management systems, such as procedures for ensuring compliance with legislation, licences, permits, and approved plans, as well as how the carrying out of activities are documented and reported. The regulatory supervision should also encompass the company's systems for pollution control and environmental monitoring, drilling and well operations techniques, production, and pipeline operations.

Representatives of the regulatory agencies should have the legal base to take appropriate action in case of violations, noncompliance, or if the operator fails to react adequately to dangerous situations. These actions can include issuing warnings, injunctions, shutting down specific operation, a complete shut-down of the installation, withdrawal of environmental licence or permit, or initiating prosecution by the relevant authority.

Authorized and qualified representatives from the regulatory agencies should have the legal base to access the installations and to see all relevant documentation and equipment at any time. The operating company shall provide for, as far as practical, the accommodation and necessary transportation.

Compliance monitoring may be carried out regularly as a part of a programme, or unscheduled in response to complaints, in connection with the issuing, renewal or modification of an authorisation, permit or licence, or in the investigation of accidents, incidents and occurrences of non-compliance. The frequency and extent of such activities should be decided by the regulatory agencies.

The regulatory agencies should establish plans for these supervisory activities. The extent and the issues to be covered should be based on the relevant regulatory requirements, the previous experience with the operators' compliance, environmental and geologic conditions, the type of activity carried out by the operator, the type of technology applied, reported accidents and incidents, and general knowledge regarding the operator and its ongoing activities. The plans should be available to the public.

Procedures should be maintained for compliance monitoring to:

- determine whether environmental management system elements and activities conform to requirements in the legislation, and are implemented effectively;
- examine line management systems and procedures, field operations, internal compliance monitoring practices, and data to see if they fulfill the company's environmental policy, objectives, and performance criteria;
- review incident reporting and remedy schemes in relation to incidents that have occurred;
- find out how identified current and potential environmental problems have been dealt with by the operator and how this is reflected in the environmental management system;
- determine compliance with relevant legislative and regulative requirements;
- identify areas for improvement, leading to progressively better environmental performance; and
- formulate the conclusions in a report, which must be well documented.

Reporting and evaluation of compliance monitoring activities (AOOGG p29)

The reports from compliance monitoring activities should include the following information:

(a) legal basis for carrying out compliance monitoring;
(b) background for carrying out the specific monitoring activity;
(c) issues covered during the inspections or audits;
(d) non-compliances or deviations found, as well as other observations;
(e) requirements regarding correcting non-compliances or deviations, including time lines and needs for reporting back to the authorities; and
(f) listing parties taking part in the inspections or audits.

The reports should be available to the public.

To prevent illegal cross-border environmental practices, the coordination of inspections with regard to installations and activities which might have transboundary impact should be encouraged.

Design and Operations (AOOGG p36)

Offshore oil and gas activities should make use of the best available and safest technologies as appropriate and be conducted in a manner to minimize impact on the environment. Operators should identify technologies and procedures to be employed for each step of the process from prospecting to exploration, development, production, platform decommissioning, and site clearance. Regulators should examine technologies and procedures proposed for use by operators and their adequacy to ensure that they are appropriate for the Arctic.

Of primary importance is the need to ensure that wells remain under control at all times during drilling, well-completion, production, and well-workover operations. This capability must be maintained even while operating under extreme conditions.

When planning an offshore oil and gas operation, a risk analysis may be used as a tool to identify potential hazards and prevent personal injuries, loss of human lives, and pollution of the environment. Criteria used for conducting such an analysis should be based on local regulatory requirements, local environmental conditions in the area of operation, and the planned operational activity.

A risk analyses should:

- address prevention of injuries, loss of human life, and pollution of the environment;
- include risk criteria that has been defined prior to conducting the analysis and document the evaluations forming the basis of the acceptance criteria;
- be used to follow the progress of activities in planning and implementation;
- identify risk that has been assessed with reference to the acceptance criteria, form the basis of systematic selection of technical operational and organizational risk to be implemented;
- be updated on a continuous basis and included as part of the decision making process; and
- systematically follow-up implemented risk reducing measures and assumptions made in the analysis to ensure safety within the defined criteria.

Technology (AOOGG p37)

Offshore platforms and other structures used for oil and gas activities in the Arctic should be designed, built, installed, maintained, and inspected to ensure their structural integrity taking into account the site-specific environmental conditions. Standards exist for the construction of fixed offshore platforms, including those constructed of steel and concrete; mobile offshore drilling units; and floating production, storage and offloading units (FPSOs). (FPSOs should be double hulled). Standards, such as those under the International Organization for Standardization (ISO), are under development for offshore artificial islands including those constructed of sand, gravel and ice. In iceberg-prone areas, provision should be made for the emergency removal of removable installations.

Employment of effective well control technology and practices including incident drills and exercises will lower the risk of blowouts and unintended release of other hazardous substances.

Blowout preventers and related equipment should be suitable for operation in subfreezing conditions. Drilling fluids, well casing programs, cements, emergency well shut-in procedures and well safety programs should also be suited to Arctic conditions including moving ice and possible subsurface permafrost.

Pipelines should be installed, operated, and maintained in a manner that minimizes disturbance of sea floor habitat and does not unreasonably interfere with other uses of the sea floor in the area. Pipelines should be installed only after a thorough survey of the seafloor for hazards or cultural resources. Design of offshore Arctic pipelines should follow recommended practices such as those from Det Norske Veritas or the American Petroleum Institute and take into account factors such as thaw settlement, near shore strudel scouring, and ice keel gouging. Pipe properties, instrumented internal inspection techniques, leak detection systems and techniques, cathodic protection, and preventive maintenance must also be considered in the design of Arctic pipelines.

Procedures (AOOGG p37)

Procedures relevant to the special conditions in arctic areas should be worked out as a part of the operator's management system.

Operators should submit a summary of the proposed project at the outset, followed by more detailed information prior to the initiation of each major activity, such as the drilling of a well. The application should describe all procedures to be employed, including those necessary to prevent harm to life and the marine environment. Special attention should be paid to operations in offshore areas underlain by permafrost.

Safe work procedures should be developed for all phases of the proposed operations, including construction activities, transportation, equipment operation and maintenance, safety tests and drills. For example, well-control exercises should be conducted regularly for each crew to develop an adequate level of response proficiency to conditions threatening a blowout. Exercises should cover a wide range of situations. As appropriate, procedures should also be developed to ensure that hot work, welding, burning, cutting, and other operations with the potential to cause ignition of flammable vapors are conducted safely. Safe work procedures may also be developed for cold work such as use of radioactive material, trenching and excavating, and work on fire suppression, gas detection or emergency shutdown devices. These procedures may include issuance of a work permit.

Procedures should be developed to protect personnel from the toxic effects of hydrogen sulfide, if it is encountered during drilling and production.

Decommissioning, and site clearance are discussed in Section 8 (**Site Clearance and Decommissioning**). Operators shall incorporate into the design of an installation needed measures to ensure that removal of the installation can be accomplished without causing significant impacts on the environment.

Human Health and Safety (AOOGG p38)

Threats to human health and safety including unsafe working conditions are factors contributing to accidents that could lead to environmental pollution. Possible threats or hazards affecting the health and safety of personnel in Arctic offshore oil and gas activities take many forms and comes from multiple sources. Principal sources include, but are not limited to, the harsh Arctic environment, the structural integrity of the installation, blowouts, fire and explosions, equipment failure, the transfer of personnel and supplies, and drilling, production, well completion, and workover operations.

All offshore activities should be conducted in a safe and skillful manner and equipment maintained in a safe condition for the health and safety of all persons and the protection of the associated facilities. All necessary precautions should be taken to control, remove, or otherwise manage any potential health, safety or fire hazards.

Management System and Work Procedures (AOOGG p38)

One way to manage potential risks is through the use of an appropriate management system. A management system or plan should address the identification of potential hazards, the evaluation of risks to the health and safety of personnel and procedures to eliminate or reduce health and safety risks (See 5.1 **Management Systems**). Management plans should:

- identify and recognize significant health and safety risks;
- evaluate significant health and safety risks;
- plan and implement actions/procedures to manage risks;
- review and test preparedness and effectiveness on a regular basis;
- establish clear lines of communication with personnel;
- provide training to personnel;
- identify appropriate personnel protection equipment; and
- communicate contents of the management plan to all personnel.

Operators should ensure that all contractors pursue established safe working environment objectives. Safe working procedures should be established for all persons, including contractors, to ensure safe working conditions for all offshore activities. In addition work permits may be required for specific work activities including hot work, cutting, and welding (see 6.3 **Design and Operations**).

Another useful tool to consider in the management or elimination of risks is through the use of a Health, Safety and Environment (HSE) Committee. HSE Committee meetings could be held to ensure that critical safety and environmental control information is communicated to all parties throughout offshore operations. HSE meetings would coordinate among the operator, contractors, and employees to ensure a mutual understanding of potential hazards in working environment. Meetings would allow employees an opportunity to express safety concerns to be addressed by the operator.

Training (AOOGG p40)

Trained operator and contract personnel are the key to safe and environmentally sound oil and gas activities. Appropriate training plans, programs, and practices addressing offshore Arctic oil and gas activities should be established and implemented for these personnel in accordance with their duties and job responsibilities. (Refer to Section 7, **Emergencies**, for information concerning response training).

All personnel should be provided with training on basic safety and environmental issues and procedures specific to the offshore environment prior to assuming their duties. This training should provide personnel with the necessary skills and knowledge needed to conduct their jobs in a safe manner, provide for health and safety of all persons, and protect the environment.

Training programs should provide instruction on the operation of equipment, offshore operating practices, offshore emergency survival and fire fighting, local or regional regulatory requirements. It should include Arctic cultural, social, and environmental concerns including marine mammal interactions as dictated by an individuals' job responsibilities. Where appropriate, indigenous and traditional knowledge should be used in training programs.

Supervisory personnel should have a thorough knowledge of the operations and the operating procedures for which they are responsible. Individuals responsible for drilling, well completion, or workover operations should be properly trained in well control. Individuals responsible for production operations should be properly trained in production safety system operations.

A person designated by the operator to be in charge of the offshore operation should have a thorough knowledge of the operations and the operating procedures they are responsible for, and training in the following areas as appropriate:

- leadership and command ability;
- communication skills;
- team building;
- crisis management; and
- installation specific emergency training.

Periodic refresher training should be provided to personnel as appropriate. As required, procedures should be developed to monitor the effectiveness of training programs.

Emergencies (AOOGG p43)

Arctic States that are party to the International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC 1990) and/or the International Convention for the Prevention of Pollution from Ships (MARPOL 1973/1978, Annex I – regulations for the prevention of pollution by oil), are required to ensure that operators have oil pollution emergency plans and that these plans are carried on board installations.

Preparedness (AOOGG p43)

Operators should establish and maintain emergency preparedness so that the mitigation of an incident will be carried out without delay in a controlled, organized, and safe manner. Risk analyses should be carried out in order to identify the accidental events that may occur and the consequences of such accidental events. Hazardous situations and accidents should be defined for the operations in question. An analysis should be carried out to design the emergency preparedness requirements so as to meet the specific circumstances of the operation. Such an analysis should include oil spill response strategies, techniques, and capabilities. The emergency preparedness required for the operation should be incorporated in the design and modification of the oil and gas installation, and for the selection of equipment. The performance requirements expected of both standby vessel and ice roads in emergencies should also be defined. This should include design criteria, equipment and manning requirements for standby vessels and design criteria and construction and maintenance requirements for roads. Emergency preparedness should be part of the safety and environmental program to ensure its integration into all phases of the operation in question.

Preparedness relating to oil pollution should ensure that the source of any oil pollution is first secured, and any release is effectively contained and collected near the source of the discharge as quickly as possible. Particular attention should be paid to response contingencies in ice conditions, where oil spill response, including containment, may require a range of techniques depending on the condition of the ice. The preparedness should also address protection of public health, environmental resources including shorelines, ice and water interfaces, and economic and cultural resources. The health and safety of all persons who may be involved in an incident (e.g., local populations and their representatives, responders, volunteers, etc.) should be a predominant consideration, and should be integrated into the overall emergency preparedness regime.

The communication within the emergency preparedness organization should ensure effective administration and control of all response resources when abnormal conditions and emergencies occur. The means of communication and their use should ensure unambiguous and effective transmission of information.

A key factor in preparedness is ensuring that personnel involved in the response are trained and instructed in their roles and duties.

Preparedness planning of the operator should include co-ordination with any relevant municipal, local, state or federal emergency response plan.

Governments are responsible for oversight including national emergency contingency planning. Governments should also make appropriate arrangements that facilitate international coordination and cooperation.

Response

Contingency Planning (AOOGG p44)
The contingency planning process is one of the key best management practices for evaluating the environmental effects of the response operation. Through the planning process, response options (e.g., no response, dispersant use, in situ burning, or mechanical recovery) can be fully evaluated under varying weather and ice conditions to decide ahead of time which options may be most successful in minimizing the effects of a spill and subsequent clean-up operations. By conducting this risk assessment through a multilateral contingency planning process such issues as disturbance to marine mammal migration from response, including ice-breaking activities can be evaluated in the context of each response measure and/or a combination of response measures. Through a multilaterally developed plan, response options would be vetted through the countries in preparation for an incident. The plan should establish training schedules so that response organizations are exercised periodically, and communicate on a regular schedule.

A multilateral Arctic response plan would delineate regional response zones, clearly identify the lead response group for each region and identify response groups to cascade in to help with the response. The plan would identify roles and responsibilities, would be maintained so contacts could be made effectively given an incident, and would identify response capabilities (personnel, equipment, platforms, communication, infrastructure, etc.) for each region.

Emergency Response Plans (AOOGG p44)

Refer to the EPPR Field Guide for Oil Spill Response in Arctic Waters for a practical introduction to oil spill response. Emergency response plans should address abnormal conditions and emergencies that can be anticipated during the oil and gas operation being carried out, including:

- personnel injury or loss of life;
- loss of well control, or release of flammable or toxic gas;
- fire, explosion or other emergencies that may occur;
- damage to the oil and gas installation;
- loss of support craft including aircraft;
- spills of oil or other pollutants; and
- hazards unique to the operation including ice encroachment; uncontrolled flooding of the installation; loss of ballast control or stability; pipeline leaks or ruptures; vessel collision; and heavy weather and difficulties with support facilities such as ice roads, aircraft or shuttle tankers.

Contents of Emergency Response Plans (AOOGG p44)

An emergency response plan should contain at least the following elements:

- a description of the response organization, clearly stating its structure, roles, responsibilities and decision-making authorities;

- policies and procedures for responding, including a summary of equipment to combat the particular condition or emergency situation, clearly stating the make and type of equipment, its capacity, location, type of transport, field of operation and operational procedures and training for operating staff. The procedures should include each key person's duties, when and how the emergency equipment is to be employed, and the action to be carried out. Policies should state measures for limiting or stopping the event in question and conditions for terminating the action. The procedures should be designed so as to be expedient to use for the emergency;
- a description of the alarm and communication systems, including notification criteria, reporting procedures and policies regarding government notification. Primary and secondary communication facilities among operational components should also be identified;
- Alert Criteria, whose procedures should list precautionary measures to secure the well and evacuate personnel in the event of damage from severe weather, sea, ice, erosion or other event;
- On-Site First Aid - List available backup medical support, medevac facilities and other emergency facilities, such as emergency fueling sites. Also describe required survival equipment, including extreme weather survival gear, alternate accommodation facilities, and emergency power sources; and
- Relief Well Arrangements - The operator should outline his immediate response to a well control incident or blowout. Also, the operator should demonstrate the availability of the necessary equipment, and support systems to be utilized.
- Designated response operation center to coordinate response actions; and
- "Emergency response contact list" in order to identify who and how key responders to an emergency are to be contacted.

Oil Spill Response Plan (AOOGG p45)

Operators should be required to have site-specific or operator-specific plans. An oil spill response plan addresses an oil spill volume based on relevant well data, catastrophic loss of a tank ship or barge, or damage to a pipeline. The Plan should be supplemented by resource sensitivity maps arranged sequentially by month for those areas identified by spill trajectories as being potentially exposed to oil pollution. The plan should also describe the process for its development, which should include involvement by response entities, both government and private, health officials, scientists, local populations that may be affected, wildlife experts, trustees of resources, and anyone else who may be affected or who may have a role in the response. Operators should allow the opportunity for public review and comment of the Plan.

The oil spill response plan should include, in addition to the items described above, the following:

- a brief description of the operation;
- a description of remote sensing systems in order to detect and monitor oil spills;
- a description of the site, water depth, seasonal constraints, and logistical support;
- references to all environmental support material that would be relevant to establish cleanup

priorities;

- details of the operator's capability in using real time wind and current data to implement an oil spill trajectory model both for open sea and for ice-infested areas;
- a map depicting sensitive areas to be protected;
- a description of cleanup and containment strategies required for shoreline and ice-covered areas;
- a description of alternative cleanup strategies such as the use of dispersants, in situ burning, and no response;
- a strategy to respond to small spills from the installation, shore base or loading operations;
- provisions for transport, storage, and disposal of recovered oil and oil contaminated materials;
- spill response crew relief & logistics; and
- a list or inventory of spill response equipment and their measured efficiency when used as expected in the plan.

Operators should have access to oil spill countermeasures equipment. The oil spill response plan should itemize equipment on-site for immediate containment purposes. The plan should also provide details of oil spill equipment and resources that are not onsite but will be mobilized in the event of a spill; the details should include type of equipment, required resources, logistics and timing of mobilizing the equipment to the site.

The oil spill response plan should include the qualifications and training of personnel responsible for the management of oil spill responses. It should clearly define their authority to take actions to respond to such emergencies.

A national preparedness and response system should be developed on the basis of protecting the health and safety, the environment, and the socio-economic interests of the nation's citizens.
Oil spill response plans must take the existence of ice conditions into account. Broken ice conditions make it difficult to respond to oil spills with conventional mechanical response equipment because oil can be trapped in melting or freezing ice and require the coordinated application of a suite of response strategies. Through ice movement and drift, oil can be carried a long distance from the original site of the spill. Deployment of oil tracking buoys in the ice can aid in maintaining knowledge of the position of the oil. Where ice conditions exist, oil spill response plans must outline the strategies to be used, list the equipment to be deployed, and techniques to be implemented including for tracking oil in ice and for alternative response measures.

Exercises and Drills (AOOGG p46)

To enhance response capabilities, response organizations should conduct regular safety and emergency response drills during which trained workers and emergency responders carry out regular exercises. Drills include desk-top exercises and actual equipment and operational deployment exercises. Such drills should be conducted by operators as well as by relevant government authorities in their areas of responsibility, such as coast guards for marine spills.

Ice Management Plan (AOOGG p47)

Where there may be pack ice, drifting icebergs or ice islands at the operational site, the operator should develop an ice management plan that provides for the protection of the installation.

The Plan should include details regarding ice detection, ice surveillance, data collection, forecasting and reporting of ice encroachment, multiyear ice hazards, ice loading, and structural loading. If required, the Plan should also include details of ice avoidance or ice deflection, including forecasting oil-in-ice drift.

The Plan should include alert criteria and alert procedures to ensure a totally effective mobilization of all relevant emergency preparedness resources, including procedures for moving the installation. Measures for danger limitation should be implemented when a hazardous situation occurs in order to prevent its developing into an accident situation.

Emergency Preparedness Maintenance (AOOGG p47)

All the established technical, operational and organizational measures that make up the emergency preparedness of the individual activity, as well as, the actual equipment should be maintained in order to keep up a state of effective emergency preparedness.

Oil spill response exercises should be carried out on a scheduled basis allowing responders to use actual equipment. In addition, a communication exercise in response to an emergency should be conducted on a scheduled basis. Exercises should be reviewed to ensure compliance with all requirements relating to emergency preparedness. Any deviation should be identified and corrected immediately; the causes of such deviation should be identified. In accordance with the safety and environmental program, emergency preparedness work should be verified and documented.

Measures should be taken to update the established emergency preparedness based on continuous evaluation of experience, technological development and new knowledge.

Definition of Practices and Techniques (AOOGG p79)

Criteria for the Definition of Practices and Techniques mentioned in Paragraph 3(b)(i) of Article 2 of the OSPAR Convention

BEST AVAILABLE TECHNIQUES (BAT)

1. The use of the best available techniques shall emphasise the use of non-waste technology, if available.
2. The term "best available techniques" means the latest stage of development (state of the art) of processes, of facilities or of methods of operation which indicate the practical suitability of a particular measure for limiting discharges, emissions and waste. In determining whether a set of processes, facilities and methods of operation constitute the best available techniques in general or individual cases, special consideration shall be

given to:

(a) comparable processes, facilities or methods of operation which have recently been successfully tried out;

(b) technological advances and changes in scientific knowledge and understanding;

(c) the economic feasibility of such techniques;

(d) time limits for installation in both new and existing plants;

(e) the nature and volume of the discharges and emissions concerned.

3. It therefore follows that what is "best available techniques" for a particular process will change with time in the light of technological advances, economic and social factors, as well as changes in scientific knowledge and understanding.

4. If the reduction of discharges and emissions resulting from the use of best available techniques does not lead to environmentally acceptable results, additional measures have to be applied.

5. "Techniques" include both the technology used and the way in which the installation is designed, built, maintained, operated and dismantled.

BEST ENVIRONMENTAL PRACTICE (BEP)

6. The term "best environmental practice" means the application of the most appropriate combination of environmental control measures and strategies. In making a selection for individual cases, at least the following graduated range of measures should be considered:

(a) the provision of information and education to the public and to users about the environmental consequences of choice of particular activities and choice of products, their use and ultimate disposal;

(b) the development and application of codes of good environmental practice which covers all aspect of the activity in the product's life;

(c) the mandatory application of labels informing users of environmental risks related to a product, its use and ultimate disposal;

(d) saving resources, including energy;

(e) making collection and disposal systems available to the public;

(f) avoiding the use of hazardous substances or products and the generation of hazardous waste;

(g) recycling, recovery and re-use;

(h) the application of economic instruments to activities, products or groups of products;

(i) establishing a system of licensing, involving a range of restrictions or a ban.

7. In determining what combination of measures constitute best environmental practice, in general or individual cases, particular consideration should be given to:

(a) the environmental hazard of the product and its production, use and ultimate disposal;

(b) the substitution by less polluting activities or substances;

(c) the scale of use;

(d) the potential environmental benefit or penalty of substitute materials or activities;

(e) advances and changes in scientific knowledge and understanding;

(f) time limits for implementation;

(g) social and economic implications.

8. It therefore follows that best environmental practice for a particular source will change with time in the light of technological advances, economic and social factors, as well as changes in scientific knowledge and understanding.

9. If the reduction of inputs resulting from the use of best environmental practice does not lead to environmentally acceptable results, additional measures have to be applied and best environmental practice redefined.

Company safety, environmental policies and objectives (AOOGG p89)

Detailed elements that may be incorporated into company safety and environmental policies and objectives

- Competent personnel are used during planning and implementation of the separate phases, including design, fabrication and installation and operation
- The operator's personnel and those of any Contractors are provided with necessary training
- Lines of responsibility, authority and communication are clearly defined and understood;
- Risk evaluation should be a part of the project management strategy in order to establish and maintain an acceptable level of health Safety and Environmental protection for the personnel and the environment;
- No activity should be performed unless and acceptable level of HSE protection can be maintained;
- Management of discharges should be achieved through the application of Best Available [Techniques/Technology]
- Experiences from arctic operations should be integrated into specifications, functional requirements, standards and procedures;
- Safety evaluations should be undertaken both prior to start-up and in subsequent phases of the operation;
- Administrative systems are established for the control of all documentation in all phases of the operation;
- Purchase documents and specifications should contain Quality Assurance requirements;
- Contractor's Quality Assurance systems should be evaluated and assessed and be the subject of regular audits;
- The quality of supplies and materials should be documented;
- Quality Assurance and Quality Control during operations should function effectively and

corrective action should be taken when quality control indications deviation from specification;

- Operational programmes should be prepared and compiled with relevant regulations and their functional capability should be subject to verification;
- Specifications for repairs should be established and specifications provide sufficient basis and requirements for their execution;
- Temporary equipment may be installed and operated in a secure way and in accordance with established specifications;
- Modifications should not reduce the degree of safety originally specified;
- An emergency preparedness system should be established and maintained so that necessary measures can be activated effectively and authorities involved notified;
- Administrative decisions made be the supervisory personnel are communicated effectively to the personnel and contractors;
- There should be continuous control and monitoring of all aspects of the working environment with regard to health safety and environmental risks and that necessary actions are implemented
- There should be continuous control and monitoring of the danger of pollution of the external environment and that personnel at all times will perform their tasks in such a way that pollution is avoided ;
- Both operator and contractor personnel should be made aware of the potential danger of accidents and inherent health and pollution aspects and they are given necessary information, training and exercises.

Appendix 3: Deepwater Horizon and Other Investigations

From Oil and Gas Producers International

Investigative Body	Reports and Other Documents
United States District Court for the Eastern District of Louisiana	Partial Consent Decree between the USA and Transocean (19 February 2013) Amendment to the Partial Consent Decree between the USA and Transocean (19 February 2013)
Deepwater Horizon Joint (BOEMRE-USCG) Investigation of Deepwater Horizon	Vol.1 (U.S. Coast Guard-Joint Investigation Team) draft report to Commandant 22 April 2011 IADC letter of 31 May 2011 to the Commandant, USCG, regarding the Vol. 1 draft report to Commandant 31 May 2011 BOEMRE Final Report regarding Macondo Well Blowout 14 September 2011 Deepwater Horizon Joint Investigation Team Releases Final Report 14 September 2011 Volume I – USCG Final Action Memo on Vol I 14 September 2011 Volume I – Enclosure to Final Action Memo 14 September 2011 Deepwater Horizon Report Appendices September 2011
Montara Commission of Inquiry	Report of the *Montara Commission of Inquiry* 17 June 2010 Final Government Response to the *Report of The Montara Commission Of Inquiry* 25 May 2011
BP	*Deepwater Horizon* Accident Investigation Report 8 September 2010
Transocean	Macondo Well Incident: Transocean Investigation Report, Vol. I June 2011

	Macondo Well Incident: Transocean Investigation Report, Vol. II June 2011
The National Commission on the Deepwater Horizon Oil Spill and Offshore Drilling	The Staff working papers were written by the staff of the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling for the use of members of the Commission. They do not necessarily reflect the views of the Commission or any of its members. A Brief History of Offshore Oil Drilling 23 August 2010 Decision-Making Within the Unified Command 11 January 2011 The Amount and Fate of the Oil 11 January 2011 The Use of Surface and Subsea Dispersants During the BP Deepwater Horizon Oil Spill 11 January 2011 The Challenges of Oil Spill Response in the Arctic 11 January 2011 Stopping the Spill: The Five-Month Effort to Kill the Macondo Well 11 January 2011 Response/Clean-Up Technology Research & Development and the BP Deepwater Horizon Oil Spill 11 January 2011 The Story of the Louisiana Berms Project 11 January 2011 Industry's Role in Supporting Health, Safety, and Environmental Standards: Options and Models for the Offshore Oil and Gas Sector 12 January 2011 Liability and Compensation Requirements under the Oil Pollution Act 11 January 2011 Scientific Research to Support Oil and Gas Decision Making: Evolution of the Department

	of the Interior's Environmental Studies Program 24 February 2011 The National Environmental Policy Act and Outer Continental Shelf Oil and Gas Activities 8 February 2011 Offshore Drilling in the Arctic: Background and Issues for the Future Consideration of Oil and Gas Activities 7 February 2011 Unlawful Discharges of Oil: Legal Authorities for Civil and Criminal Enforcement and Damage Recovery 24 February 2011 Long-Term Regional Restoration in the Gulf: Funding Sources and Governance Structures 24 February 2011 Rebuilding an Appetite for Gulf Seafood after Deepwater Horizon 7 February 2011 Natural Resource Damage Assessment: Evolution, Current Practice, and Preliminary Findings Related to the Deepwater Horizon Oil Spill 7 February 2011 Continuous Improvement Is Essential: Leveraging Global Data and Consistent Standards for Safe Offshore Operations 11 January 2011 A Competent and Nimble Regulator: A New Approach to Risk Assessment and Management 8 February 2011 Federal Environmental Review of Oil and Gas Activities in the Gulf of Mexico: Environmental Consultations, Permits, and Authorizations 12 January 2011 The History of Offshore Oil and Gas in the United States (long version) 11 January 2011 Chief Counsel's Report

	17 February 2011 Final report of the *National Commission on the Deepwater Horizon Oil Spill and Offshore Drilling* 11 January 20
Oil Spill Commission *Action*	The oil Spill Commission *Action* (OCSA) project is an outgrowth of the National Commission (above) supported of many of the original Commissioners. OSCA Assessment Report on the status of implementation of the Commission's recommendations (17 April 2012)
Republic of the Marshall Islands	DEEPWATER HORIZON MARINE CASUALTY INVESTIGATION REPORT (low resolution version) 17 August 2011
Harvard Law School **Emmet Environmental Law and Policy Clinic**	Recommendations for Improved Oversight of Offshore Drilling Based on a Review of 40 Regulatory Regimes (June 2012) Appendix – Regulatory Programs and Organizations Analyzed January-April 2012
University of California, Berkeley — Center for Catastrophic Risk Management	*"Deepwater Horizon Study Group Final Report on the Investigation of the Macondo Well Blowout"* 1 March 2011
U.S. Chemical Safety Board Investigation of Deepwater Horizon	Investigation currently underway
National Academy of Engineering– Analysis of Causes of Deepwater Horizon Explosion, Fire, and Oil Spill to Identify Measures to Prevent Similar Accidents in the Future	Interim Report on Causes of the Deepwater Horizon Oil Rig Blowout and Ways to Prevent Such Events 16 November 2010 Macondo Well-Deepwater Horizon Blowout: Lessons for Offshore Drilling Safety (Prepublication version) 14 December 2011
Transportation Research Board	Transportation Research Board Special Report 309: Evaluating the Effectiveness of Offshore Safety and Environmental Management Systems June 2012
Petroleum Safety Authority Norway – Macondo Incident	Preliminary conclusions by the Petroleum Safety Authority Norway (PSA) and action recommended after the Deepwater Horizon accident (English summary) 9 June 2011 SINTEF Executive Summary of report commissioned by the Petroleum Safety Authority May 2011
Norwegian Oil Industry Association (OLF) **Deepwater Horizon –**	OLF's Deepwater Horizon Report – In English (84 pages) OLF's summary Report – In English (20 Pages)

lessons learned and follow up	June 2012
UK Health and Safety Executive – Deepwater Horizon incident in the Gulf of Mexico	The Health and Safety Executive's Offshore Division is monitoring the situation in the Gulf of Mexico following the fatal explosion on the Deepwater Horizon drilling rig in April 2010 and has created a website (link at left) to report on its findings, observations and actions.
UK Ministerial commissioned Independent Review for the Deepwater Horizon/Macondo incident	Offshore Oil and Gas in the UK – an independent review of the regulatory regime December 2011 Government Response to an Independent Review of the Regulatory Regime, Department of Energy & Climate Change, December 2012
International Organization for Standardization – Subcommittee on Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries	Proposed ISO/TC 67 programme for drilling, well construction and well operations standards, resulting from the Montara and Macondo accidents (N 1119) 1 March 2011
International Maritime Organization (IMO)	Casualty Statistics and Investigation, Report of the Correspondence Group on Casualty Analysis (FSI 21/5) addressing, *inter alia*, the explosion, fire and loss of the Mobile Offshore Drilling Unit **Deepwater Horizon**
International Association of Oil and Gas Producers (OGP)	International recommendations on well incident prevention, intervention and response Global Industry Response Group recommendations (Summary) May 2011 Oil Spill Response May 2011 Capping & Containment May 2011 Deepwater Wells May 2011

Appendix 4: HSE Guidance (not complete please supply additional information on guidance for HSE Management Systems. OGP and IADC may have this information compiled) We will also add weblinks to these documents.

Iris and U of Stavanger for PSA
Technology and Operational Challenges in the High North
October 2011

Transportation Research Board of the National Academies
Effectiveness of Safety and Environmental Management Systems for Outer Continental Shelf Oil and Gas Operations Interim Report 2011

PSA
The Thought Process
HSE and Culture

Greenland Bureau of Minerals and Petroleum
Exploration Drilling Guidelines May 2011

OSPAR
Recommendation 2003/5 to Promote the Use and Implementation of Environmental Management Systems by the Offshore Industry 2003

IRF

North Sea Offshore Authorities Forum (NSOAF)

ICRARD (International Committee on Regulatory Research and Development)
www.icrard.org primarily has information on HSE-related research and development projects in the USA, Canada, the United Kingdom and Norway.

G-20
GMEP Best Practices

OGP
'Guidelines for the Development and Applications of Health, Safety and Environmental Management Systems' 2003
2012

- **Catalogue of international standards used in the oil & gas industry**

2011

- **Managing health for field operations in oil and gas activities**
- **Process safety: recommended practice on key performance indicators**
- **Environmental performance in the E&P industry – 2010 data**
- **HSE guidelines for metocean surveys including Arctic areas**
- **Human factors engineering in projects**
- **Safety performance indicators – 2010 data**

- **Health and Safety data reporting system users guide – 2010 data**
- **Substance Misuse: a guide for managers & supervisors in the oil & gas industry**

UK Health and Safety Executive

- **Reducing Error and Influencing Behaviour**
- **Improving Maintenance; A guide to reducing human error**
- **Culture & Work Environments Elements**

Step Change
Changing Minds - A Practical Guide for Behavioural Change in the Oil & Gas Industry

Shell Exploration & Production
Hearts and Minds Tools, 2002

Human Engineering for the Health & Safety Executive
Culture & Work Environments Elements Research Report 365 2005

International Standards Organization Documents
ISO TC 67 Arctic Offshore Structures
ISO 17776 Petroleum and natural gas industries - Offshore production installations - Guidelines on tools and techniques for hazard identification and risk assessment
ISO 14001:1996, Environmental management systems - Specification with guidance for use
ISO14004:1996, **Environmental management systems - General guidelines on principles, systems and supporting techniques**

American Petroleum Institute
API RP 75 and 74L HSE Management Systems
http://publications.api.org/Exploration-Production.aspx

International Association of Drilling Contractors (IADC): www.iadc.org
Health Safety and Environment Case Guidelines for Mobile Offshore Drilling Units
November 2011

E&P FORUM
Guidelines for the Development and Application of Health, Safety and Environmental Management Systems Report No. 6.36/210

[Appendix 5

Countries current work (Countries can update their progress on initiatives being implemented after the Deepwater Horizon/Macondo well accident—these may or may not be part of the Report, they may also be well placed on the Management, Regulation and Enforcement information website managed by PAME).

NEB
The NEB Strategic Plan 2012-2015 will focus on developing guidance for the D&P Regulations on Data acquisition, Incident reporting, Geotechnical considerations, Well abandonment and suspension, and Financial responsibility, as well as, on creating performance measures and audit protocols.
1) performance safety metrics that influence hazards identification and risk management;
2) senior leadership and its role in safety culture; and
3) management systems effectiveness and implementation.

US BSEE

- Safety Culture Policy Draft (comments closed March 20. 2013)
- The Safety and Environmental Management Systems (SEMS) II final rule (Aril 4, 2013) (with greater employee participation, empowering field level personnel with safety management decisions, and strengthening oversight by requiring audits to be conducted by accredited third-parties.)
- Ocean Safety Institute June 2013
- Rule Making Process for Arctic Standards, December 2013.

USCG

- Safety & Environmental Management System (SEMS) ANPRM to be published in FR
- Training and Manning on the US OCS ANPRM to be published in FR
- 33 CFR Subchapter "N" Update Rule Making Process (SNPRM) ongoing
- OCS Marine Casualty Reporting Rule Making Process (NPRM) ongoing

Norway
Barriers
Managements Role in Risk Management

Potential Changes in Alaska

- Blowout contingency plan as part of Permits to Drill
- Relief well capability requirements. The State is looking at requiring that the operator can demonstrate ready capability to drill a relief well if needed.
- Well control certifications
  - Personnel. The State is considering changing the number of persons with well control certification to 2 or 3 that must be on the rig at all times
  - Equipment. The State is considering more stringent certification for all well control equipment, both new to the State and existing

- Clarification of regulations. Alaska is looking at clarifying regulations where they feel they leave too much latitude for interpretation
  - Emphasis on performance standards.
  - Guidance where needed.
- Incorporation of industry Recommended Practices (RP) and Standards. The State is considering incorporating more industry standards into regulations.
  - RP 53 → Standard 53 API RP 53 is a critical part of our regulations on well control equipment.
  - Casing and cementing standards]

[i] NEB Arctic Offshore Review 2013