

Review of Offshore Oil-spill Prevention and Remediation Requirements and Practices in Newfoundland and Labrador

December 2010

Client:

**Department of Natural Resources
Government of Newfoundland and Labrador**

Primary Author:

Captain Mark Turner

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Government of Newfoundland and Labrador
P.O. Box 8700
St. John's, NL
A1B 4J6

Primary Author:

Captain Mark Turner
P.O. Box 5367
St. John's, NL
A1C 5W2
mgt@naplp.com

“Roll on, thou deep and dark blue Ocean - roll!

Ten thousand fleets sweep over thee in vain;

Man marks the earth with ruin - his control

Stops with the shore; upon the watery plain

The wrecks are all thy deed, nor doth remain

A shadow of man's ravage, save his own,

When, for a moment, like a drop of rain,

He sinks into thy depths with bubbling groan,

Without a grave, unknell'd, uncoffin'd and

Unknown”.

Byron

Childe Harold's Pilgrimage

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Preface

The following report deals with various aspects of the oil-spill prevention, response and remediation requirements and practices within the Province of Newfoundland and Labrador. Specific focus is given to an evaluation of the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) in relation to its role in oil-spill prevention, preparedness and response effectiveness. Various comparisons to other jurisdictions are provided, including Norway, the United Kingdom, Australia and the United States. The comparisons are performed to determine the highest standards worldwide and establish whether the C-NLOPB is performing up to this standard.

The report is broken down into six sections. Section 1 is the executive summary. It expresses why the report came about, the terms of reference, a summary of the Macondo blowout, findings specific to Newfoundland and Labrador, international comparisons and compensation regimes. The section is concluded with a list of recommendations as a result of the review.

Section 2 discusses the history and background of petroleum activities in the Newfoundland and Labrador offshore oil industry. Topics include the Atlantic Accord, the creation of the C-NLOPB, the current status of petroleum activities in the Province and the need for deepwater drilling.

Section 3 focuses on oil-spill prevention activities for Newfoundland and Labrador offshore installations. Topics include general prevention measures, the approval and regulatory process in Newfoundland and Labrador, additional measures invoked for the Chevron Lona O-55 deepwater well, detailed prevention measures, regulation philosophy and comparisons to comparable jurisdictions.

Section 4 reviews oil-spill response and remediation activities in Newfoundland and Labrador. Topics include Canada's legislative and regulatory regimes, Canada's marine oil-spill preparedness and response regime, environmental effects on spill-response in Newfoundland and Labrador, tanker-spill response considerations, and comparisons to comparable jurisdictions.

Section 5 evaluates Canada's compensation regime for oil-spill damage. Specific topics include response cost, compensation for ship-source spills, the international compensation regime, compensation for damages from offshore petroleum activities, and current liability limits.

Section 6 provides evidenced-based conclusions and recommendations covering a variety of topics as a result of this review.

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Abbreviations

ABS	American Bureau of Shipping
ACDP	Acoustic Doppler Current Profiler
ADEC	Alaska Department of Environmental Conservation
ADW	Approval to Drill a Well
ALERT	Atlantic Emergency Response Team
AMF	Automode Function
AMOSC	Australian Marine Oil-spill Centre
AMSA	Australian Maritime Safety Authority
APD	Application for Permit to Drill (US)
API	American Petroleum Institute
AR	Activities Regulations (Norway)
ASTM	American Society for Testing and Materials
AVIRIS	Airborne Visible Infrared Imaging Spectrometer
AWO	Approvals for Well Operations
BAST	Best Available and Safest Technologies
BOEMRE	Bureau of Ocean Energy Management - Management and Enforcement (US)
BOP	Blowout Preventer
BOSRC	Basics of Oil-spill response Course
BP	Formerly British Petroleum
CA	Certifying Authority
CAPP	Canadian Association of Petroleum Producers
CCC	California Coastal Commission
CCG	Canadian Coast Guard
CCO	Chief Conservation Officer
CEAA	Canadian Environmental Assessment Agency
CFR	Code of Federal Regulations (US)
CIMAS	Cooperative Institute for Marine and Atmospheric Studies
CLC	Civil Liability Convention
C-NLOPB	Canada - Newfoundland and Labrador Offshore Petroleum Board
C-NSOPB	Canada - Nova Scotia Offshore Petroleum Board
COGLA	Canada Oil and Gas Lands Administration
COSO	Committee of Sponsoring Organizations of the Treadway Commission

CPR	Counter Pollution and Response Branch
DCV	Directional Control Valve
DECC	Department of Energy and Climate Change
DFO	Department of Fisheries and Oceans Canada
DLMC	Dragon Lance Management Corporation
DNV	Det Norske Veritas
DP	Dynamically Positioned
DPP	Development and Production Plan (US)
ECRC	Eastern Canada Response Corporation
EDU-ED	Environment & Decommissioning
EDU-LED	Licensing Exploration and Development
EP	Exploration Plan (US)
EPFR	Emergency Prevention, Preparedness and Response
ERAC	Environmental Research Advisory Council
EROEI	Energy Returned on Energy Invested
FAI	Fail As Is
FaR	Facilities Regulations (Norway)
FOSC	Federal On-Scene Commander
FPSO	Floating Production Storage and Offloading vessel
FSC	Fail-Safe Close
GBS	Gravity Base Structure
GESAMP	Group of Experts on the Scientific Aspects of Marine Pollution
HAZWOPER	Hazardous Waste Operations and Emergency Response Standard
HMDC	Hibernia Management and Development Company
HPHT	High Pressure - High Temperature
HPU	Hydraulic Power Unit
HSE	Hibernia Southern Extension
HSE	Health and Safety Executive
HSE	Health, Safety and Environment
IADC	International Association of Drilling Contractors
IC	Internal Control
IIP	International Ice Patrol
IMO	International Maritime Organization
IOPC	International Oil Pollution Compensation

IPIECA	International Petroleum Industry Environment Conservation Association
IRF	International Regulators Forum
ISB	In-situ Burning
I-STOP	Integrated Satellite Tracking of Polluter's
ITOPF	International Tanker Owner Pollution Federation
JOHSC	Joint Occupational Health and Safety Committee
LMRP	Lower Marine Riser Package
LR	Lloyd's Register of Shipping
LWD	Log While Drilling
MAGIC	Multi-Agency Geographic Information for the Countryside
MCA	Maritime and Coastguard Agency
MCTS	Marine Communication and Traffic Services
MGsva	University of Miami's Rosenstiel School of Marine and Atmospheric Science
MLA	Marine Liability Act
MMS	Minerals Management Service
MOC	Management of Change
MODU	Mobile Offshore Drilling Unit
MOU	Memorandum of Understanding
MPa	MegaPascals (unit of pressure equal to 1,000 kPa)
MPCF	Maritime Pollution Claims Fund
MSROC	Marine Spill-response Operations Course
MUX	Multiplex
MWD	Measurement While Drilling
NASP	National Aerial Surveillance Program
NCA	Norwegian Coastal Administration
NCEP	National Centers for Environmental Prediction
NCP	National Contingency Plan
NEB	National Energy Board
NEB	Net Environmental Benefit
NEP	National Energy Program
NOAA	National Oceanic and Atmospheric Administration
NOFO	Norwegian Clean Seas Association for Operating Companies
NOPSA	National Offshore Petroleum Safety Authority
NORSOK	NorskSokkelsKonkuranseposisjon (Norway)

NOSCS	National Oil-spill Contingency System
NPD	Norwegian Petroleum Directorate
NRC	National Research Council
NRC	Nuclear Regulatory Commission
NRCan	Natural Resources Canada
NRDA	Natural Resource Damage Assessment
NRT	National Response Team
NSCS	National Spill Control School
NTL	Notice to Lessees (US)
OA	Operations Authorization
OCS	Outer Continental Shelf
OECD	Organization for Economic Co-operation and Development
OIMS	Operations Integrity Management System
OMA	Oil-Mineral Aggregate
OPA 90	Oil Pollution Fund 1990
OPEP	Oil Pollution Emergency Plan
OPOL	Offshore Pollution Liability Association Ltd.
OSC	On-scene Commander
OSCC	On-Scene Commanders Course
OSHA	Occupational Safety and Health Administration
OSLTF	Oil-spill Liability Trust Fund
OSP	Operations Safety Plans
OSPRAG	Oil-spill Prevention and Response Advisory Group
OSR	Oil-spill Response
OSRR	Oil-spill Response Research
OWTG	Offshore Waste Treatment Guidelines
PDIP	PDI Production Incorporated
PPP	Polluter-Pays-Principle
PREP	Preparedness for Response Exercise Program
PSA	Petroleum Safety Authority (Norway)
PTMS	Point Tupper Marine Services Ltd.
PVT	Pressure, Volume and Temperature
QRA	Quantitative Risk Assessment
RAC	Regional Advisory Council

REET	Regional Environmental Emergencies Team
RO	Response Organization
ROM-CPS	Regional Operation Managers - Counter Pollution and Salvage
ROV	Remotely Operated Vehicle
RPS	Response Planning Standard
RTTS	Retrievable Test Treat Squeeze Packer
SCE	Safety Critical Equipment
SDR	Special Drawing Rights
SEA	Strategic Environmental Assessment
SEDAC	Socioeconomic Data and Applications Center
SEM	Subsea Electronic Module
SEMS	Safety and Environmental Management System
SMART	Special Monitoring of Applied Response Technologies
SMS	Safety Management Systems
SONS	Spill of National Significance
SOPF	Ship-source Oil Pollution Fund
STP	Standard Temperature and Pressure
TC	Transport Canada
USCG	United States Coast Guard
VRP	Vessel Response Plan
WCMRC	Western Canada Marine Response Corporation
WHOI	Woods Hole Oceanographic Institution
WMO	World Meteorological Association
WWF	World Wildlife Fund

Section 1 – Executive Summary

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1.0 Executive Summary

1.1 Initiation of this Review

From the outset and on behalf of the Province of Newfoundland and Labrador, the authors extend their deepest sympathies and condolences to the families and friends of the 11 workers who lost their lives onboard the Deepwater Horizon in the Gulf of Mexico on April 20, 2010.

The spill from the Macondo well¹ in the Gulf of Mexico is the largest offshore spill in U.S. history and among the largest ever worldwide. The well was estimated to have been discharging as much as 60 000 barrels per day. The location of the spill was in 1 500 metres of water, with a formation depth of 5 600 metres.

Immediately after the Gulf of Mexico incident, the Department of Natural Resources, Government of Newfoundland and Labrador required that an independent review be conducted of the legislative and regulatory regimes, capabilities and practices in place in the Province directed toward prevention and remediation of oil-spills in the Province's offshore. The unfortunate incident in the Gulf of Mexico has raised questions about the likelihood of such an event occurring in the Newfoundland and Labrador offshore and the collective degree of preparedness to deal with such an incident if it were to occur.

On May 12, 2010, Kathy Dunderdale, the minister of Natural Resources at the time of the Macondo incident, stated "Safety and the protection of the environment are paramount in our offshore. We are closely monitoring the situation in the Gulf and we have had discussions with the Canada-Newfoundland and Labrador Offshore Petroleum Board regarding industry operations here. At this point, we are satisfied with the level of environmental protection. At the same time, an independent review will help us ensure industry is doing everything it can to prevent and respond to any incident in the offshore (Department of Natural Resources, 2010)."

This document presents the results of the independent review. The terms of reference are outlined in the next section.

¹Most well-related spills are referred to by the well name, in this case, Macondo. The incident has been referred to in other literature as the Deepwater Horizon and Mississippi Canyon 252.

1.2 Terms of Reference

Purpose: The Department of Natural Resources, Government of Newfoundland and Labrador, has a requirement for an independent review of the legislative and regulatory regimes, capabilities and practices in place in the Province directed toward prevention and remediation of oil-spills in the Province's offshore.

The consultant will undertake the following:

- Review and report on the effectiveness of legislative and regulatory regimes, capabilities and practices in place to prevent an oil-spill associated with an installation in the Newfoundland and Labrador area.
- Review and report on the effectiveness of legislative and regulatory regimes, capabilities and practices in place to respond to and remediate an oil-spill in the Newfoundland and Labrador offshore area, including from ship sources involving tankers dedicated to the offshore industry or oil-tanker traffic generally.
- Provide a comparison in these reviews to the requirements, capabilities and practices in other comparable jurisdictions internationally including Norway, the United Kingdom, Australia and the Gulf of Mexico. The comparisons take into account the physical environment in each of these jurisdictions.
- Review and report on how the liability for costs of oil-spill response and cleanup is determined and apportioned amongst relevant parties in the Newfoundland and Labrador offshore area, and review and report on the nature and extent of, and responsibility for, third-party damages associated with oil-spills in the Newfoundland and Labrador offshore area.
- Develop evidence-based conclusions from the above noted reviews and submit any recommendations for changes that, if implemented, would bring the legislative and regulatory regimes, capabilities and practices in Newfoundland and Labrador in line with the most progressive regimes, capabilities and best practices internationally.

1.3 The Macondo Blowout

Due to a blowout on April 20, 2010, the Deepwater Horizon, a 9-year old dynamically positioned semi-submersible Mobile Offshore Drilling Unit (MODU), exploded and sank about 77 kilometres off the Louisiana coast in the Gulf of Mexico. The incident claimed the lives of 11 workers and injured 17 others. Another 98 people survived without serious physical injury.

Various attempts by BP to seal the leak were unsuccessful, until July 20, 2010, after a new containment cap was installed. The drilling of two relief-wells continued so the well could be permanently killed. The completion of the relief-wells was completed in September, 2010. Drilling and cleanup operations were interrupted periodically by storms, this being the norm with the onset of hurricane season.

The Deepwater Horizon was owned by Transocean and was registered under the Marshalese flag of convenience. The rig was working on Block 252, an exploratory well known as the Macondo Prospect. The proposed well was to be drilled to 5 600 metres below sea level, and was to be plugged and suspended for subsequent completion as a subsea producer. Production casing was run and cemented prior to the time of the explosion. Upon completion, the well was tested for integrity and a cement plug installed to temporarily abandon the well for later completion (Brenner, Guegel, Pitt, & Watts, 2010).

The Deepwater Horizon tragedy, the loss of eleven lives, and the effects of the oil-spill will undoubtedly require a thorough examination of the causes. It will require a re-evaluation of spill prevention, response, containment and cleanup capabilities, as well as a complete and vigorous review of appropriate regulations and how they are enforced so that a similar disaster is avoided.

The Macondo blowout will undoubtedly have a huge impact on deepwater drilling in the United States. Ken Salazar, the Interior Secretary has made “major changes” to regulations and ordered the breakup of the Minerals Management Service to bolster its focus on safety. There are now three independent agencies, the two Bureaus still answering to the Department of the Interior while the Office of Natural Resources answers to the Secretary for Policy.

Bureau of Ocean Energy Management: A new bureau under the supervision of the Assistant Secretary for Lands and Minerals Management that will be responsible for the sustainable development of Outer Continental Shelf conventional and renewable energy resources, including resource evaluation, planning and other activities related to leasing.

Bureau of Safety and Environmental Enforcement: A bureau under the supervision of the Assistant Secretary for Land and Minerals Management that will be responsible for ensuring comprehensive oversight, safety and environmental protection in all offshore energy activities.

Office of Natural Resources Revenue: An office under the supervision of the Assistant Secretary for Policy, Management and Budget that will be responsible for the royalty and revenue management function including the collection and distribution of revenue, auditing and compliance, and asset management.

The global community closely watched this devastating incident unfold in the Gulf of Mexico. Some countries including Canada, Norway, the United Kingdom and Australia immediately took action in relation to deepwater drilling within their own jurisdictions by enhanced oversight measures.

While some countries such as Norway suspended deepwater drilling pending the investigation and findings of the Macondo blowout, Newfoundland and Labrador continued with its deepwater offshore drilling operations.

On June 19, 2010 The Telegram indicated that Kathy Dunderdale, Minister of Natural Resources, Newfoundland and Labrador, defended the Government's decision not to suspend deepwater drilling in the wake of the Gulf of Mexico disaster: "We do not support such a decision at this time because we have confidence in the regulatory regime in our offshore area and we do not have the facts of what occurred in the Gulf. Our safety record, combined with new oversight arrangements that our regulator has put in place, allows us to continue exploration while building into our regime any lessons that emerge from the Gulf of Mexico." The Minister further added, "The Government of Newfoundland and Labrador is extremely concerned about this situation, and we are continually monitoring what is happening in the Gulf of Mexico to acquire any lessons that we can learn and apply to the Province's offshore drilling environment." The Gulf disaster "demonstrates yet again that constant vigilance is necessary", to reduce risks and create a safe workplace in the offshore oil and gas industry.

In the wake of the Gulf of Mexico oil-spill catastrophe we ask ourselves - what caused the explosion, loss of life and subsequent oil-spill and how can we prevent such an unfortunate event from occurring here off Newfoundland and Labrador?

First of all, while there are assumptions as to why control of the well was lost, it is still as of yet unknown. This report does not speculate as to the possible causes of the spill. Once the investigative findings are presented, then and only then will we have conclusive evidence surrounding the mishap.

The Deepwater Horizon disaster affects the global community. Certainly there will be changes as to how we look and deal with deepwater drilling. We have to evaluate the risks and consequences in our quest for deeper offshore oil. Every oil-producing country will now have to evaluate the technology and the risks associated with deepwater drilling. Our regulatory regimes must first and foremost hold safety, human health and the environment as paramount.

1.4 Findings Specific to Newfoundland and Labrador

Newfoundland and Labrador has a relatively young offshore oil industry. First oil occurred at the Hibernia platform in November 1997, representing less than 15 years of production within the Province. Despite the youth of the industry, Newfoundland and Labrador has amassed an impressive record of safety and success with respect to offshore exploration and development. The C-NLOPB, our Province's regulatory body, was initially moulded after the Norwegian system to establish an effective regulatory structure to represent the best interest of the people and the environment of Newfoundland and Labrador. Throughout the years the C-NLOPB has matured into a world leader with respect to safety and regulatory oversight.

With regard to oil-spill prevention, the C-NLOPB has numerous mitigative measures and requirements currently in place. To obtain approval to implement an operator installation, an operator must submit numerous plans, including a Development Plan, Canada-Newfoundland and Labrador Benefits Plan and a Reservoir Depletion Plan. As well, as part of an initial Operations Authorization, a Concept Safety Analysis is required.

Individual drilling programs require their own two-tiered process. First, authorization of the overall drilling program must be achieved through an Operators Authorization. Second, a well approval for an individual well must be obtained in the form of an Approval to Drill a Well as part of the drilling program application. Relevant regulatory approvals within the context of the operations authorization include a Project-Specific Environmental Assessment, a Certificate of Fitness, an Operator's Declaration of Fitness, a Letter of Compliance from Transport Canada, Safety Plans, an Environmental Protection Plan and Contingency Plans. The Approval to Drill a Well must provide detailed information regarding the planned drilling program. The Board provides guidelines for drilling and production, which focus on critical matters with respect to well-control and blowout prevention. The guidelines reflect high standards and modern thinking in the areas of drilling, cementing and well-control matters. These guidelines can be updated to incorporate lessons learned to improve upon the current standard.

In addition to the approval process, the C-NLOPB provides additional levels of oversight as required by the *Atlantic Accord Implementation Act*. Oversight is accomplished through auditing, compliance monitoring, scheduled inspections and investigations.

As a result of the Macondo blowout, the C-NLOPB took extra precautions with respect to the Lona O-55 deepwater well. The additional measures included the establishment of an oversight team, daily reports from the operator, bi-weekly oversight meetings, filed reports indicating pressure testing of the BOP and function testing of the backup systems, requirements to follow the Macondo incident to incorporate

lessons learned, increased audit and inspection frequency, mandatory operator time-outs prior to significant operations, and the presence of a C-NLOPB onboard observer. Additional information regarding prevention, the regulatory process and the Lona O-55 additional measures can be found in Section 3.

When an oil and gas project is first proposed for offshore Newfoundland and Labrador, the operator is required by law to have comprehensive emergency response plans, procedures, equipment, and trained personnel in place prior to the C-NLOPB approving their activities. The emergency response plan is a detailed plan designed to first protect people and the environment and then minimize damage to equipment and facilities.

The oil industry also has a partnership with Government. Potential polluters have a legal responsibility, entrenched in the *Canada Shipping Act*, to undertake preparedness measures and to pay for repairing or mitigating damage to the marine environment. Ships and designated oil-handling facilities are required to have an arrangement in place with government-certified response organizations.

Environmental Response Systems is responsible for the development and administration of policies, regulations, and programs that protect the marine environment, mitigate the impact on the environment of marine pollution incidents and to ensure the safety of the general public. It works with other federal agencies and departments including Fisheries and Oceans Canada, the Canadian Coast Guard, and Environment Canada.

Another important program is Canada's Marine Oil-spill Preparedness and Response Regime, which is based on the Polluter-Pays-Principle. Transport Canada is the lead federal regulatory agency responsible for the regime and is built on a partnership between Government and industry. Transport Canada sets the guidelines and regulatory structure for preparedness and response to marine oil-spills.

Canada also participates in joint activities with the United States and has established a formal Canada – U.S. Joint Marine Pollution Contingency Plan. The regime is governed by the following legislation and International Conventions: *Canada Shipping Act*, Dangerous Chemicals and Noxious Substances Regulations, Oil-pollution Prevention Regulations, Pollutant-discharge Reporting Regulations, Response Organization and Oil-handling Facilities Regulations, *Arctic Waters Pollution Prevention Act*, *Oceans Act*, *Fisheries Act*, International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), International Convention on Oil-pollution Preparedness, Response and Cooperation (OPRC 90), International Oil-pollution Compensation Fund, Civil Liability Convention, and the Salvage Convention.

The majority of the focus of this review deals with offshore activity for existing installations, but additional consideration is also provided for tanker spills. Within the framework of the Marine Oil-spill

Preparedness and Response Regime, Transport Canada sets the guidelines and regulatory structure for the preparedness and response to marine oil-spills and is built on the principles of designated areas of primary risk, tiered-response structure, equipment and time standards and response strategy.

Subsequent to the *Exxon Valdez* oil-spill in 1989, and the recommendations of the Brander-Smith Panel that followed, the Canadian Coast Guard and Environment Canada overhauled the regime for tanker-spill-response.

In 2005, Transport Canada commissioned a study on the current and future risks of oil-spills in Newfoundland and Labrador waters related to marine traffic. The resulting study, “Quantitative Assessment of Oil-spill Risk for the South Coast of Newfoundland and Labrador”, covers the entire south coast of Newfoundland, from Cape St. Francis (east near St. John’s) to Cape Ray (west near Port aux Basques), including Placentia Bay to the 50 mile limit. The study included the assessment of both of the key components of risk: the probability of an oil-spill occurring and the consequences of the spill should it occur. Key elements included stakeholder consultation, oil-spill frequency, environmental impact assessment, economic impact assessment, risk results and conclusion, and area specific factors and future trends.

One of the key findings of the risk-assessment project indicates that the most probable area for a spill is in inner Placentia Bay. That risk has decreased over the years, primarily due to increased preventative measures that have been implemented, including the phase-in of double-hulled tankers, the requirement to have contracts with response organizations, and increased monitoring and inspections. The findings also conclude that while Placentia Bay is a busy port, the traffic density is low relative to other areas of the world.

The study was circulated amongst all stakeholders and resulted in the submission of 25 proposals. All proposals were given a review, and plans of action for implementing a number of the worthy concepts have been recently approved.

For additional detail concerning oil-spill response and remediation please refer to Section 4. For general information relating to frequently asked questions concerning prevention, response and remediation in Newfoundland and Labrador, please refer to Appendix I.

1.5 International Comparisons

The oil industry and regulatory authorities of Newfoundland and Labrador, Norway, the United Kingdom, Australia and the United States have made commitments to satisfy the energy needs of their respective nations while maintaining safe and environmentally sound operations. This commitment demands preparedness and continuous improvement throughout every phase of exploration and production where oil is produced, transported, stored or marketed. Prevention is considered the most critical area in all jurisdictions, with considerable efforts being placed to ensure the risk of a spill is as low as reasonably possible. With respect to well control, all jurisdictions use advanced prevention technologies and practices, with multiple back-up safety systems such as blowout preventers, various activation devices, and additional shut-off valves.

In addition to prevention, oil-spill response is also of the upmost importance. All regulatory regimes under study acknowledge that the speed and effectiveness of a response operation is greatly enhanced through the advance planning, training and coordination of a response system. Response decision-making will vary on a case-by-case basis, being influenced by factors such as the type and amount of oil spilled, the ecosystem where the spill occurred, and the type of response tools required. When evaluating these variables, the Net Environmental Benefit Analysis (NEBA) is used. This mechanism balances the potential impacts of an oil spill against the impacts of the available response options.

To continually improve safety measures within the industry related to both prevention and response, the regulatory agencies share information through the International Regulators Forum (IRF). The IRF works to coordinate national offshore regulating bodies to help improve the industries health and safety standards and performance worldwide. The main goal of the forum is to promote safe global practices in the offshore industry that coincide with best economic practices. The forum also looks to exchange valuable information between countries, including health and safety trends, safety performance, lessons learned, best practices, regulatory practice and regulatory effectiveness. Through bodies like the IRF, a social fabric committed to safety, and regulatory authority willingness to adapt and change, all jurisdictions have shown a strong devotion to safety, a desire to minimize the probability of an oil-spill, and effective measures of response and remediation should an oil-spill occur.

Several differences between jurisdictions occur due to differences in the physical environments in which production takes place. A study of the physical environment of Newfoundland and Labrador as well as the other jurisdictions has been conducted as part of this review. These may be found in Appendix II and III, respectively.

1.6 Compensation Regimes

Compensation for pollution damage caused by spills from ships is governed by an international regime under the auspices of the International Maritime Organization (IMO). The Conventions are known as the 1992 Civil Liability Convention (CLC) and the 1992 Fund Convention.

The CLC applies strict liability for shipowners and creates a compulsory liability insurance system. The Fund Convention establishes a regime for compensating claimants when the CLC compensation is inadequate. The regime established under the CLC and Fund Convention has proven very successful over the years. If a pollution incident from a ship occurs, governments or other authorities, private bodies, industries or individuals who have incurred costs or suffered damages can be compensated. Canada, Norway, United Kingdom and Australia are signatories to the CLC and the Fund Convention. The United States has its own domestic legislation for compensation in the form of the Oil Pollution Act 1990. Canada, while being party to the CLC and Fund Convention also has its own Ship-source Oil-pollution Fund (SOPF) that can be used to pay for claims if said claims exceed the 1992 Fund limit.

Offshore-oil operations may also pose a risk of damage to the environment, to the property and economic interests of people working in and living in areas affected by such operations. Damages may take the form of a “spill” or as a result of “debris” left on the ocean floor.

The C-NLOPB is the authority for matters of compensation in Newfoundland and Labrador. Compensation may be obtained through the industry directly, through the Board or through Court action.

Current Canadian laws cap a company’s potential liability for damages from a spill at \$40-million in Arctic waters and \$30-million off Eastern Canada. This \$30-million limit is very low when compared with potential costs of a large-scale spill and significantly lower than other developed countries.

The United States has a similar limit through the Oil Spill Liability Trust Fund where offshore rig operators face no more than \$75-million in liability. Subsequent to the Macondo spill, legislators are calling for it to be raised as high as \$10-billion. The Oil Pollution Act also requires operators to provide financial assurance of at least \$35-million and may rise to \$150-million.

Whereas Australia enforces the polluter-pays-principle, the current law does not place any specific liability on operators to pay for clean-up or environmental damages caused by spills. Companies are only legally required to have insurance to cover the costs of complying with directions relating to the clean-up or other remediation activities.

The United Kingdom has a strict liability regime in the form of the Offshore Pollution Liability Agreement (OPOL). OPOL liability limits have recently been increased to US \$250-million per incident.

1.7 Summary of Conclusions and Recommendations

As a result of this study, it is concluded that the C-NLOPB is a responsible, competent, and effective regulatory body committed to maintaining a world-class standard. Whereas no guarantee can be given that a significant spill will not occur in the Newfoundland and Labrador offshore, the people of Newfoundland and Labrador can be assured that the Board continues to work diligently to ensure our offshore industry operates with safety as its highest priority. Through up-to-date goal-orientated regulations, careful oversight of offshore activities, international regulatory involvement and a continued commitment to improvement, the C-NLOPB has established itself as a highly respected and world-class organization.

Despite the high standard established by the Board, continuous improvement is always needed to maintain this standard. To further enhance the effectiveness of Newfoundland and Labrador and Canada's role in preventing and responding to spills, several recommendations are provided. A summary of the recommendations is provided below. For further details, please refer to section 6.

It is recommended that:

1. A dispersant-use capability program be established for Newfoundland and Labrador waters, including the development of a pre-approval process.
2. Establish a means of reviewing and performing relevant research to determine if the use of dispersants can provide a net environmental benefit, and if so, require offshore operators to include the use of dispersants in their oil-spill response plans.
3. Create and fund a system in an appropriate department (Environment Canada) to approve commercial dispersant products that can be used in the waters off Newfoundland and Labrador.
4. Define areas and conditions for the Newfoundland and Labrador offshore in which dispersant usage can be pre-approved.
5. Establish standards for effectiveness and effects monitoring and monitor training similar to the Special Monitoring of Applied Response Technology (SMART) Protocols in the United States. In addition, consideration should also be given to the possibility of dispersant injection at the wellhead, in the event of a subsea oil-well blowout.
6. In-situ burning capability should be considered and developed for Newfoundland and Labrador.
7. Pre-approval for in-situ burning operations, both in open-waters and ice-covered conditions, should have defined standards for effectiveness and effects monitoring.

8. Ensure appropriate response equipment, techniques and training are accessible and listed in Contingency Plans.
9. Transport Canada continues to undertake initiatives to further enhance its National Aerial Surveillance Program. This may include, but is not limited to, an increase in flight surveillance frequency, improvements to the technology used to detect spills, and the expansion of pollution surveillance areas.
10. Transport Canada should continue its diligence in monitoring, enforcement, and conviction activities. Transport Canada must be consistent and stringent in its processes to demonstrate that spills of any sort will not be acceptable in Canadian waters.
11. Transport Canada ensure that all recommendations highlighted in their assessments be implemented in a timely fashion to ensure the likelihood of an oil-spill is minimized and that the region is as prepared as reasonably possible in the event of an oil-spill.
12. Transport Canada continues to uphold an effective line of communication with its stakeholders to identify oil-spill research needs and establish priorities for future activities. These priorities may be used to direct oil-spill research and development activities at Environment Canada, disseminate any findings, and provide advice to regional and federal agencies managing oil-spills.
13. Transport Canada continues with public engagements and takes measures to improve emergency preparedness at local, regional and international levels to ensure they are commensurate with the level of the risks that exist. This is achieved by continuing to provide forums for information exchange and collaboration, in support of the objectives for improving oil-spill prevention, preparedness and response.
14. Transport Canada participates in oil-spill research programs, keeping educated and up-to-date with modernization.
15. Transport Canada actively participates in researching and utilizing all new oil-spill countermeasure technology, including, but not limited to, mechanical recovery, chemical treating agents, in-situ burning, and natural attenuation.
16. The C-NLOPB, in partnership with industry, create a mechanism that will ensure appropriate research and development (R&D) activities are confirmed, scheduled, and delivered commensurate with associated risks offshore Newfoundland and Labrador. It may be advisable that the Board ensure that prior to receiving an Approval to Drill a Well, the operator provide the

nature of the R&D initiatives, the perceived outcome, the cost, and the proposed timeframe for delivery.

17. The C-NLOPB continue being vigilant in its regulatory oversight responsibility and keep the highest level of scrutiny in relation to its mandate of worker safety, environmental protection, resource management and industrial benefits. This involves the continuance of a high safety standard application and a strict robust monitoring and reporting system. It should also be recognized, that as our industry grows, so shall the oversight responsibilities of the C-NLOPB. This continued growth will require additional financial resources.
18. The C-NLOPB must continue with international involvement, which is an important vehicle that ensures that lessons and practices are shared with relevant regulators and operating companies.
19. The C-NLOPB must keep exploring ways to implement more effective and smarter regulatory frameworks without compromising any aspect of the environment or health and safety of employees or the public.
20. The C-NLOPB must demonstrate more transparency and find ways to communicate industry information and analysis in ways that are accessible to a broad audience. This may be achieved by the Board and industry jointly, by creating an educational and awareness policy for the public and all stakeholders.
21. Government adhere to the senate committee recommendation regarding liability limits in Canada. Specifically, a comprehensive review of the liability limits must be undertaken with the ultimate goal of adjusting the threshold to a value that better represents today's current economic realities.
22. The C-NLOPB require operators to develop a strategic contingency plan dealing specifically with blowouts. The plan should encompass a total system approach to blowout control, management response and recovery, and demonstrate an acceptable level of preparedness, and the critical resources to manage an incident effectively, including hazard management, incident management, qualification management, information management, and technology management. The plan should not be static but tested to ensure reliability, safety team building and overall confidence.
23. The C-NLOPB hold more industry seminars to transfer the knowledge of technology related to deepwater and high pressure/high temperature wells to the local community. This will further strengthen its regulatory efforts and show leadership within the local community.
24. The C-NLOPB modify the current *Canada-Newfoundland Offshore Petroleum Board Drilling and Production Guidelines* to:

- Require, particularly for deepwater wells or wells with anticipated high subsurface temperature and pressure, a comprehensive well-control management plan comprising all of the policies and procedures, equipment standards and training and competencies that ensure well-control during drilling operations, including risk assessment for loss of well-control;
 - Include formation fluid influx in the definition of “incident”;
 - Ensure automatic disconnect of the stack is undertaken when maximum riser angle is reached (deepwater operations only);
 - Remote intervention is available for subsea BOP stacks for all water depths;
 - One set of shear rams for deepwater BOP stacks is capable of shearing casing;
 - Shear boost systems are considered for BOP stacks installed on platforms;
 - Require, particularly for deepwater wells or wells with anticipated high subsurface temperature and pressure, verification of well design prior to issuance of Approval to Drill a Well; and,
 - Reconcile with the *Guidelines for Drilling Equipment*, as revised 2007.
25. Third-party auditing be implemented and become normal practice in the Newfoundland and Labrador offshore oil industry, particularly for deepwater wells or wells with high anticipated pressure and temperature. Such auditing should address the adequacy of well design and the implementation of the well-control management system during drilling operations.

Section 2 – History and Background

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2.0 History and Background

2.1 Canada's Petroleum Industry

The Canadian petroleum industry is an important factor in the economy of North America. Canada is the seventh largest oil-producing country in the world and in 2008 produced an average of 438 000 cubic metres per day (2 750 000 bbl/day) of crude oil, crude bitumen and natural gas condensate. Of that amount, 45% was conventional crude oil and approximately 283 000 cubic metres (1 780 000 bbl/day) was exported to the United States, making Canada the largest single source of oil imports into the U.S.

Canada's petroleum industry has developed hand in hand with the United States. Canada's first oil well was established by James Williams in 1858. The well, dug by hand to a total depth of 20 metres, was located outside of an asphalt plant in Oil Springs, Ontario. Following the discovery, Mr. Williams later formed "The Canadian Oil Company", Canada's first petroleum company. Williams' discovery occurred one year prior to the first discovery in the United States (Petroleum History Society, 2010).

Because of Canada's unique geography, geology, resources and patterns of settlement, it developed in different ways. The evolution of the petroleum sector has been a key factor in the history of Canada and helps illustrate how the country became quite distinct from her neighbour to the south.

Major players in the Canadian petroleum industry include Imperial Oil, Husky Energy, Suncor Energy, Shell Canada, ConocoPhillips Canada, Statoil Canada, En Cana Corporation, Canadian Natural Resources Limited, Talisman Energy, ExxonMobil Canada, Devon Canada Corporation, and Cenovus Energy. Canadian petroleum production is currently a vital component of the national economy and an essential element of world supply.

2.2 Development of Newfoundland and Labrador's Petroleum Industry

Offshore petroleum activity in Newfoundland and Labrador began in 1963, with the first exploration well being drilled in 1966. Factors including environmental challenges and jurisdictional conflicts impeded the development and scale of offshore activity. Hibernia, the first commercial field was discovered in 1979 and its development was delayed until 1990, with first production commencing in 1997. Terra Nova, a second field, was discovered in 1984 and started production in 2002. White Rose, the third field, was discovered in 1984 and began production in 2005. Hebron, the fourth field, was discovered in 1981 with production anticipated for 2017.

Newfoundland and Labrador's offshore petroleum industry emerged over this 40-year period and resulted in or contributed to the development and enhancement of construction, education, and training, fabrication, supply and services, and research and development. The industry has had a profound effect on the Province's economy.

2.2.1 The Atlantic Accord

In 1985, the Atlantic Accord agreement was signed between the Government of Newfoundland and Labrador and the Government of Canada. A similar agreement was also signed with the Province of Nova Scotia. The issue of resource ownership was set aside even though that had been decided by the federal Court. The Atlantic Accord, among other things, established a joint management system for the offshore resources, giving the Province benefits as if they were located on land. In 1987, the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) was established to administer and manage offshore resources on behalf of both levels of Government. The C-NLOPB is a federal and provincial authority established by the joint operation of Section 9 of the *Canada-Newfoundland Atlantic Accord Implementation Act*, R.S. 1987, c.3, as amended, (collectively, the "Acts") (C-NLOPB, 2010).

The purposes of the Atlantic Accord are:

- a) to provide for the development of oil and gas resources offshore Newfoundland for the benefit of Canada as a whole and Newfoundland and Labrador in particular;
- b) to protect, preserve and advance the attainment of national self-sufficiency and security of supply;
- c) to recognize the right of Newfoundland and Labrador to be the principle beneficiary of the oil and gas resources off its shores, consistent with the requirement for a strong and united Canada;
- d) to recognize the equality of both Governments in the management of the resource, and ensure that the pace and manner of development optimizes the social and economic benefits to Canada as a whole and to Newfoundland and Labrador in particular;

- e) to provide that the Government of Newfoundland and Labrador can establish and collect resource revenues as if these resources were on land, within the Province;
- f) to provide for a stable and fair offshore management regime for industry;
- g) to provide for a stable and permanent arrangement for the management of the offshore adjacent to Newfoundland by enacting the relevant provisions of this Accord in Legislation of the Parliament of Canada and the Legislature of Newfoundland and Labrador and by providing that the Accord may only be amended by the mutual consent of both Governments; and
- h) to promote within the system of joint management, insofar as is appropriate, consistency with the management regimes established for the offshore areas in Canada.

On the 25th anniversary of the signing of the Atlantic Accord, Acting Premier Kathy Dunderdale acknowledged the important work of the negotiators and signatories to the historic agreement that created the development of the Newfoundland and Labrador offshore oil and gas industry.

“This was a pivotal point in our Province’s history and it precipitated the development of our first major and pioneer offshore oil project, Hibernia, which has returned substantial benefits to the people of the Province and Canada,” ...“When the Atlantic Accord was negotiated, we had a fair share of skeptics who didn’t buy into the vision shared by signatories to this agreement. Now 25 years later, we have three successful producing oil projects and a fourth in development.”

“We also have a robust supply and service sector poised to serve future projects in the Province and to offer its capabilities and expertise in new frontiers. Our oil industry continues to flourish. It is the main fiscal engine that drives our provincial economy and represents nearly 40 per cent of our Province’s Gross Domestic Product (Government of Newfoundland and Labrador, 2010).”

The initial formal joint agreement between the Province and the Government of Canada embodied the general principles of the Atlantic Accord in the 1984 letter from Prime Minister Mulroney to Premier Brian Peckford. Spanning nearly 15 years of rejected federal initiatives, the offshore issue and the inability to resolve it had perturbed and preoccupied those concerned with the future of the Province and the rights of its people to participate equally in the Canadian Confederation.

Whereas equality is the thrust of the Accord, Newfoundland and Labrador also contributes to Canada and enjoys the same pride and satisfaction of other producing Provinces. The Atlantic Accord demonstrates what can be achieved through perseverance, understanding and good will. Newfoundland and Labrador, like other producing Provinces, is interested in attaining the goal of national energy self-sufficiency and

security of supply. The Atlantic Accord was a new and bright chapter in the history of the management of our offshore resources.

2.2.2 Current Projects

The Newfoundland and Labrador offshore oil industry began with the Hibernia project and continues to grow today. Each offshore project faced major challenges, including a lack of available infrastructure, technology, local capabilities, but there has been continuous improvement, development and application of lessons learned.



Figure 1 - The Hibernia Production Platform

Source: (HMDC, 2010)

The Hibernia field was discovered in 1979 and is located 315 kilometres east-southeast of St. John's, Newfoundland and Labrador. Located in the Jeanne D'Arc Basin in 80 metres of water, the C-NLOPB estimates that the field contains 1 395 million barrels of recoverable oil. Oil is produced at Hibernia by means of a fixed production platform, shown in Figure 1. The platform consists of a Gravity Based Structure (GBS), topsides drilling derricks and production facilities. It is operated by Hibernia Management and Development Company Ltd. (HMDC).



Figure 2 - The Terra Nova FPSO

Source: (Newfoundland and Labrador Refining Corporation, 2010)

The Terra Nova field was discovered in 1984 and is located 360 kilometres east-southeast of St. John's. The field is located in the Jeanne D'arc Basin in 90 metres of water and has a field reserves estimate at 406 million barrels. Oil at the field is produced by means of a FPSO, also named Terra Nova, shown in Figure 2. The field is operated by Suncor Energy Inc.

The White Rose field was discovered in 1984 and is located approximately 350 kilometres east of St. John's. The field is located on the northern margin of the Jeanne D'Arc Basin in approximately 120 metres of water. Oil is being produced using a FPSO, named the Sea Rose, shown in Figure 3. The field is operated by Husky Energy.

The offshore oil and gas industry is of critical importance to the Newfoundland and Labrador economy. The industry creates jobs, opportunities for local businesses and investment in research and development, education, training and infrastructure. The Province also benefits from the royalties and taxes paid by the industry.

A summary of the economic benefits is presented below (CAPP, 2010):

- Approximately \$2.2 billion in oil royalties were paid to Newfoundland and Labrador in the 2008-2009 fiscal year and the industry contributed approximately 28% of provincial Government revenues.
- The industry had spent \$16 billion in capital in Newfoundland and Labrador since 1995.
- Over 3 000 people are directly employed by the industry. Thousands more work in the supply and service sector.



Figure 3 - The Sea Rose FPSO

Source: (Offshore Technology, 2010)

2.3 The Canada-Newfoundland and Labrador Offshore Petroleum Board

The Canada-Newfoundland and Labrador Offshore Petroleum Board was established in 1987 under the Atlantic Accord to regulate offshore oil and gas activity on behalf of the Governments of Canada and Newfoundland and Labrador and to embody the general principles and details of the Atlantic Accord. The Board is an important administrative body whereby the objectives of both Ottawa and the Province are met and it represents a new management system structured to meet the objectives set out in the Atlantic Accord.

As a strong, co-operative and effective joint agency, the C-NLOPB understands the complexity of its responsibility as a regulator. The oil and gas industry it oversees is a complex, highly technical and fast evolving industry. The Board must deal effectively and transparently with critical issues regarding safety, environmental protection, resource management and industrial benefits.

The regulation of the offshore oil and gas industry is crucial to the health and safety of its workforce. The approach to safety regulation varies from country to country and depends on the maturity of local industry, the use of prescriptive versus performance-based regulations and the methodology used by the respective regulators to enforce and promote safety.

The C-NLOPB is similar to Norway's Petroleum Safety Authority, the United Kingdom's Health and Safety Executive and Australia's National Offshore Petroleum Safety Authority. It is the specific regulatory authority responsible for the regulation and enforcement of safety in offshore Newfoundland and Labrador. The aforementioned authorities were created through lessons learned and after offshore disasters such as the loss of the *Alexander L Kielland* (1980), the *Ocean Ranger* (1982) and the *Piper Alpha* (1988). Information regarding the safety authorities of Norway, the United Kingdom, Australia and the United States is provided throughout this report.

2.3.1 Recent Initiatives within the C-NLOPB

Transparency

Subsequent to the Deepwater Horizon incident in the Gulf of Mexico, the C-NLOPB has come under criticism for what some persons believe to be an unwillingness of the Board to disclose information. The author of this study found the criticism to be without merit and largely the result of misunderstanding about the legislative structure under which the Board operates.

The C-NLOPB must comply with the legislation under which it was created in 1987, namely the *Atlantic Accord Implementation Acts* (federal and provincial). The Board's ability to disclose information is governed by Section 119 (federal version) of the Act (Section 115 in the provincial version). The

legislation establishes a process whereby some information provided to the Board by Operators is considered 'privileged'. Such information can only be released to the public with the express permission of the Operator(s). It also defines information such as contingency plans that is not privileged and can be released by the Board, with the appropriate redaction of personal, proprietary or security sensitive information.

When the C-NLOPB receives a request from the public for what is considered to be privileged information, the C-NLOPB forwards a request to the Operator(s) seeking permission to release said information. If the Operator(s) does not grant permission, the C-NLOPB will inform the party who initially made the request. This process has created the mistaken impression that it is the Board who is denying the request when it is actually the Operator.

In spite of the issues created for the Board by Section 119, examples were found where the Board has demonstrated a commitment to the principles of openness and transparency. The Board has been making improvements in its transparency and to the amount of information that it releases to the public. Some of these examples are outlined below:

- The C-NLOPB is engaged in a major initiative to develop a Digital Data Management System at a cost of approximately \$3 million;
- In 2006, the Board began posting spill data on its website even though this information is arguably privileged information provided by Operators;
- In 2009, the Board began posting Environmental Effects Monitoring data on its website. This undertaking took considerable effort and resources to complete;
- The C-NLOPB website was modified in 2008 and is undergoing continual improvement to make it the primary vehicle for information disclosure;
- The C-NLOPB provided additional resources to its Information Resource Centre to improve records management, which makes it easier to fulfill requests for information; and
- The C-NLOPB has made oil-spill response plans available to the public.

Initial reports in the media about the release of oil-spill response plans questioned why certain information had been redacted, particularly, information regarding oil-spill trajectory models and oil-spill response management. The C-NLOPB quickly addressed the problem by announcing that it would reverse the decision and make the documents available with this information included. The Chair and CEO, Max Ruelokke, stated that the information had been redacted by mistake and that measures were being put in place to prevent similar occurrences in the future.

The C-NLOPB website contains a vast amount of information about regulation of the Newfoundland and Labrador offshore oil and gas industry. The website has undergone major revisions in recent years and is still a work in progress. The information on the website is timely, accurate and relevant, but improvements can be made.

In the process of reviewing the Board's information disclosure policies and practices, it was found that the Board is very responsive to the public's right to know, despite the restrictions imposed by legislation. The Board balances the public right to know and the appropriate protection of sensitive proprietary information in a manner that maintains trust and confidence in the Board's ability to regulate in the best interest of Canadians and Newfoundlanders and Labradorians. It is a difficult task and the Board acknowledges that improvements can and will be made in this area. It has also stated that in recognition of the public's need to know, the C-NLOPB will err on the side of transparency when there is uncertainty about disclosure.

Drilling and Production Regulations

The initial Drilling Regulations were amalgamated with the Production and Conservation Regulations and modernized due to significant duplication. The new Regulations improve the existing framework to support the frontier and offshore oil and gas industry's continued growth and contribution to Canada's economy and competitiveness while maintaining the highest standards for safety, environmental protection and management of resources.

For drilling and production activities, the Regulations will resolve regulatory duplication, move from a prescriptive to goal-oriented style, incorporate a management systems approach, facilitate regulatory process improvements and reduce the administrative burden. Further information on this topic can be found in Section 3.

2.4 Current Activity

2.4.1 Producing Projects

Newfoundland and Labrador currently has three production operations: Hibernia, Terra Nova and White Rose. All three are located in the Jeanne D'Arc Basin of the Grand Banks, approximately 300 kilometres east of St. John's. In late 2009, the cumulative production for the projects surpassed 1 billion barrels, representing a significant milestone for the Province. The production for 2009 from each platform was 45.9, 29.0 and 22.8 million barrels for Hibernia, Terra Nova and White Rose, respectively (C-NLOPB, 2010). This accounts for a total of 97.7 million barrels produced in 2009.

Hibernia

Hibernia began production on November 17, 1997. The field is Newfoundland and Labrador's first and largest, contributing 47% of the total oil produced in 2009 and 61% of the cumulative oil produced since the start of production (666.6 million barrels as of January 1, 2010). The latest C-NLOPB reserve estimates for Hibernia include 1 395 million barrels of oil, 1.984 trillion cubic feet of natural gas and 225 million barrels of natural gas liquids (C-NLOPB, 2010).

Terra Nova

The Terra Nova FPSO was brought on location on August 4, 2001, with first oil being produced on January 20, 2002. The second of Newfoundland's fields, Terra Nova contributed 30% of the total oil produced in 2009 and 26% of the cumulative oil produced since 1997 (286.5 million barrels as of January 1, 2010). The latest C-NLOPB reserve estimates for Terra Nova include 419 million barrels of oil, 53 billion cubic feet of natural gas and 4 million barrels of natural gas liquids (C-NLOPB, 2010).

White Rose

The Sea Rose FPSO was commissioned on November 12, 2005 at the Cow Head Fabrication facility in Marystown. The third and most recent of Newfoundland's fields, White Rose contributed 23% of the total oil produced in 2009 and 13% of the cumulative oil produced since 1997 (137.1 million barrels as of January 1, 2010). The latest C-NLOPB reserve estimates for White Rose field include 305 million barrels of oil, 3.02 trillion cubic feet of natural gas and 96 million barrels of natural gas liquids (C-NLOPB, 2010). The estimates include the main White Rose field, the South White Rose extension and the West White Rose and North Avalon pools. They do not include an additional 68 million barrels of oil and 315 million cubic feet of natural gas located in the North Amethyst field (C-NLOPB, 2010).

2.4.2 Projects under Development

Hebron

In August 20, 2008 a formal agreement was signed between the Newfoundland and Labrador Government and various co-venture partners to develop the Hebron offshore development project (C-NLOPB, 2010). The Province will retain a 4.9% equity stake through Nalcor Energy. The project is located between the three existing operations, approximately 8 kilometres north of Terra Nova.

The Hebron project will produce from the Hebron main field. C-NLOPB reserve estimates for the Hebron discovery include 581 million barrels of oil (C-NLOPB, 2010). The Ben Nevis and West Ben Nevis include an additional 150 million barrels of oil, 429 billion cubic feet of natural gas and 30 million barrels of natural gas liquids (C-NLOPB, 2010). The main Hebron formation has heavier oil than its predecessors at 21 degrees API. First oil is expected by 2017.

White Rose Extensions

Since the development of the main White Rose field, several satellite fields surrounding the current operation have been discovered. These fields include the North Amethyst, West White Rose and South White Rose. The South White Rose Tie-Back project received approval in September 2007, whereas North Amethyst Tie-Back Project received approval in April 2008 (C-NLOPB, 2010). Evaluation of the resource potential for West White Rose is ongoing.

The developments for the White Rose satellite fields will follow a new development agreement in which the provincial Government, through Nalcor Energy, will have a 5% equity stake in the operations.

Construction of subsea components for the North Amethyst field along with modification to the Sea Rose FPSO were completed in 2009 and first oil occurred in mid 2010. The current C-NLOPB estimate of the recoverable oil is 68 million barrels, with an additional 60 million barrels having been announced by project operator Husky Energy in 2009 (C-NLOPB, 2010).

Hibernia Southern Extension

Drilling in 2005 and 2006 around the Hibernia field confirmed significant volumes of oil in the southern area of the field. Current C-NLOPB reserve estimates indicate 220 million barrels of recoverable oil; 50 million in the “AA” block and 170 in the Hibernia South area (C-NLOPB, 2010).

A MOU was signed between the Hibernia partners and the Province on June 16, 2009 concerning development of HSE. The “AA” block has been approved for development through an amendment to the original development plan. The producer for this block was drilled from the platform in 2009, whereas the

water injector was drilled in 2010. As part of the development agreement, production from this reservoir block is subject to a higher royalty rate of 42.5% of net revenues (C-NLOPB, 2010).

Subsea tie-back wells will be required for field development in the Hibernia South area. The MOU contains a provision that gives the provincial Government, through Nalcor Energy, a 10% equity state in the new developments, as well as enhancing the royalty scheme. Formal agreements were reached between the Province and its industry partners on February 16, 2010.

2.4.3 Regional Activity

East Coast Offshore

In 2009, a call for bids on a 9 558 hectare area was held. The area is located in the Jeanne D’Arc Basin near the White Rose production license. Husky Oil and Suncor were the successful bidders at \$36.8 million (C-NLOPB, 2010).

Recent exploration drilling activity for the east coast offshore has taken place in several basins, including the Jeanne D’Arc, Flemish Pass, and Orphan. These basins, along with the remaining basins of Newfoundland and Labrador, are shown in Figure 4.

Statoil Canada spudded the Mizzen O-16 well in the Flemish Pass Basin in December 2008. The well is in approximately 1100 metres of water with a total depth of 3 756 metres. Hydrocarbons were discovered and an application for a Significant Discovery License has been issued (C-NLOPB, 2010).

Suncor Energy spudded the Ballicatters M-96 well in the Jeanne D’Arc Basin in July 2009. Drilling of the well was completed in October 2009, but information is currently under a two-year confidentiality period (C-NLOPB, 2010).

Chevron spudded the LonaO-55 well in the Orphan Basin in May 2010. As a result of the Deepwater Horizon disaster, special oversight was imposed by the C-NLOPB governing the drilling of this well. Further information regarding this oversight is provided in Section 3.4.

South Coast Offshore

Two calls for bids were issued in 2009 on land parcels in the Laurentian Basin. The successful bidders were a partnership between ConocoPhillips Canada Resources Corporation and BHP Billiton Petroleum Corporation. The land parcels were sold for approximately \$8 million and \$1 million, respectively (C-NLOPB, 2010).

ConocoPhillips spudded the East Wolverine G-37 well in the Laurentian Basin in November 2009. The well targeted a formation on the east side of the French baguette, in water depths of approximately 2 000 metres (C-NLOPB, 2010). The *Stena Carron* drillship was used for this well; the same drillship that

drilled the Lona O-55 well in the Orphan Basin. Seismic surveys were also planned for the south coast region. Husky Energy obtained the rights to survey land in the Sydney Basin, and completed the survey in 2010 (C-NLOPB, 2010).

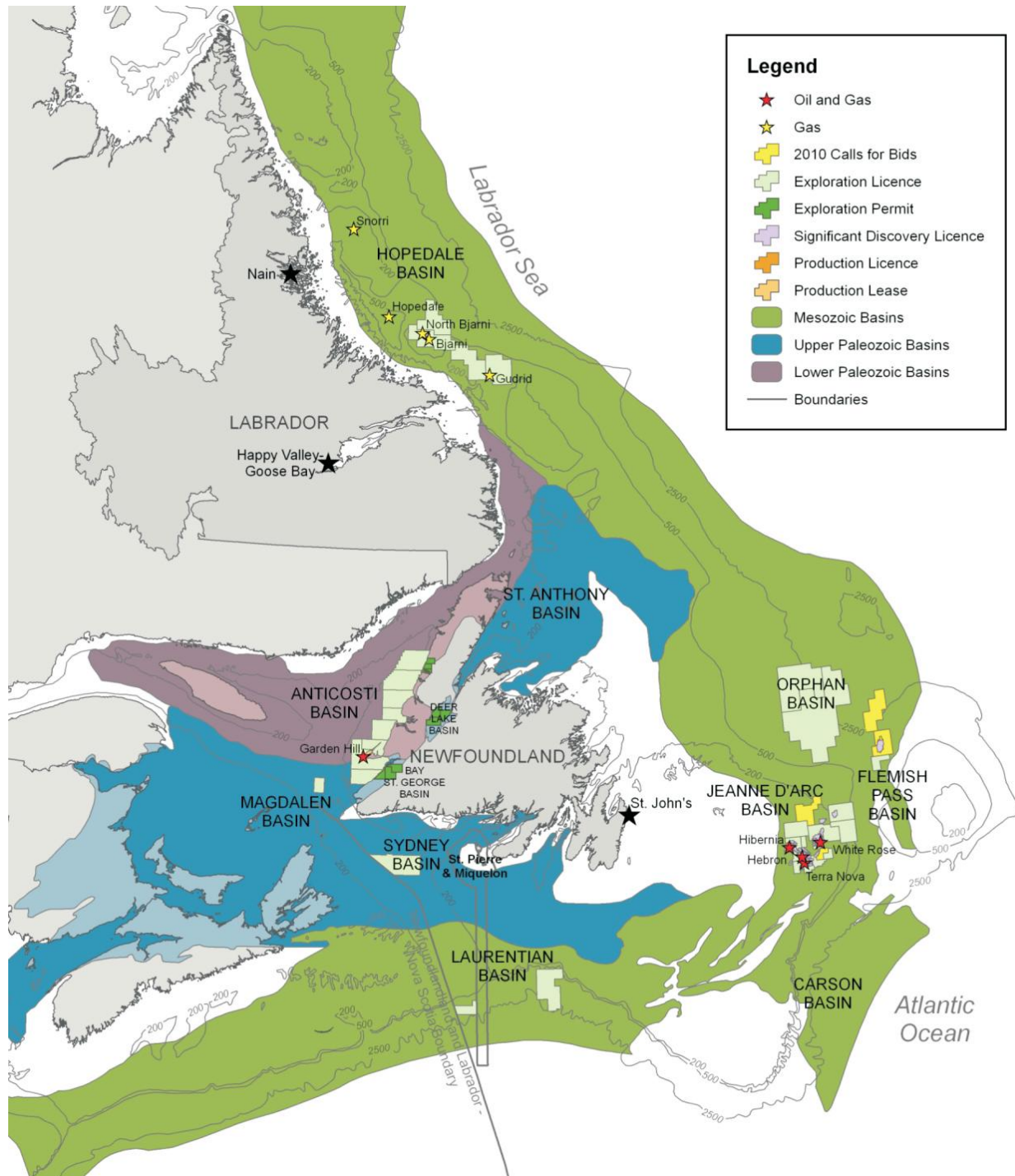


Figure 4 - Sedimentary Basins of Newfoundland and Labrador

Source: (Department of Natural Resources, 2010)

West Coast Offshore

Significant petroleum activity is occurring offshore on the west coast of the Province. The Anticosti Basin recently had a large area sold to Ptarmigan Energy Incorporated for approximately \$1.2 million. Seismic work is also taking place in the region, as performed by NWest Energy Incorporated in 2008. Analysis of the data reveals positive signs of good hydrocarbon structures. Additional formations of interest exist, including the St. Georges Group play and the Green Point formation. These areas are undergoing ownership and operational changes.

Labrador Offshore

Several significant natural gas discoveries have been found off the Labrador shelf, including the Snorri, Hopedale, Bjarni, North Bjarni and Gudrid locations, shown in Figure 5. In 2009, several documents were filed by multiple companies to conduct 2D and 3D seismic surveys in their respective exploration licensed areas. These include Husky Energy, Chevron Canada Resources and Investcan Energy Corporation.

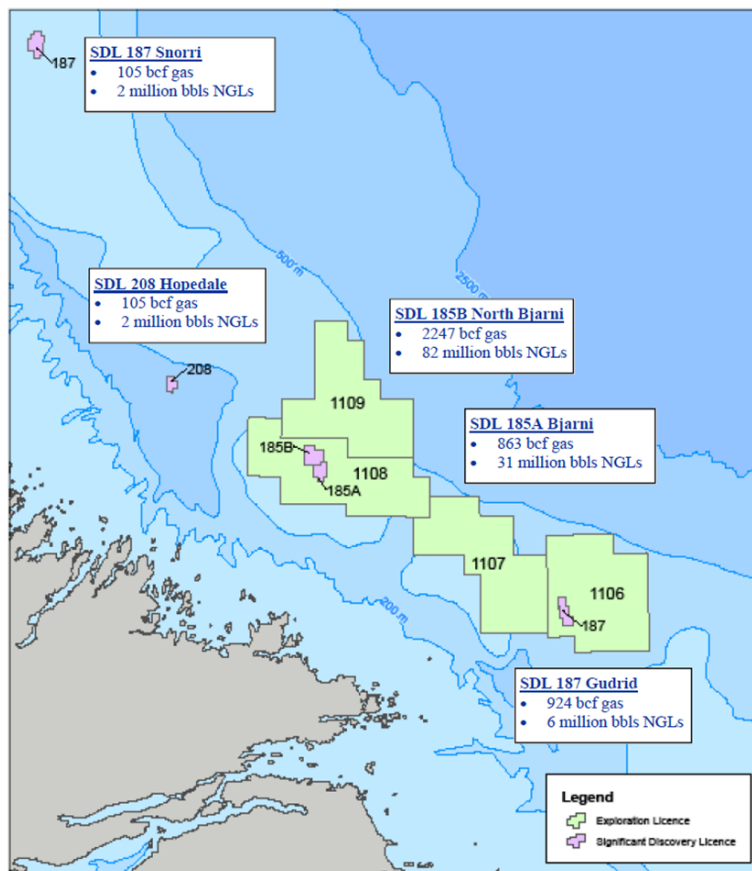


Figure 5 - Labrador Regional Map

Source: (Department of Natural Resources, 2010)

2.5 The Need for Deepwater Drilling

Deepwater drilling is not a new activity and deepwater wells are among the most promising new sources of oil, particularly since many are in politically stable regions. There will always be risks with any offshore drilling operation.

The Gulf of Mexico provides 97 percent of federal Outer Continental Shelf (OCS) production. The Gulf of Mexico has nearly 7 000 active leases, 58 percent of which are in deepwater (McClatchy, 2010). The Pacific OCS has 49 active leases off the coast of Southern California, 43 of which are producing. Alaska has 67 active leases and production from a single joint-State-Federal field. The Atlantic does not have any active leases.

Since 1947, more than 50 000 wells have been drilled in the Federal Gulf of Mexico, and there are now approximately 3 600 structures in the Gulf. In 2009, production from these structures accounted for 31 percent of total domestic oil production and 11 percent of total domestic marketed natural gas production. Over the last 15 years, leasing, drilling and production advanced steadily into deeper waters.

The number of deepwater rigs increased 43% over 2006 to April 2010. In the U.S. Gulf of Mexico alone, deepwater operations produced 30% of the U.S. oil output and represented more than 60% of the Gulf of Mexico production. New technology has played a large role in the Gulf discoveries by enabling exploration in the deepest recesses of the region, which in turn is seen as a viable alternative source of oil to OPEC imports.

Worldwide, the oil industry also recognizes deepwater drilling as central to its future, with some of the most promising reserves located off the coasts of stable western-friendly countries like Brazil, Norway, Canada and the U.S. According to Cambridge Energy Research Associates, global deepwater production is expected to rise by two-thirds to 10 million barrels a day, within the next five years (Mufson, 2010). That amount is equivalent to that produced by Saudi Arabia, the world's largest exporter.

2.6 Deepwater Drilling off Newfoundland and Labrador

Newfoundland and Labrador proceeded with its oil exploration in ultra-deepwater with the Lona O-55 well because of the confidence held in the safety practices of the industry and the C-NLOPB, which practices a robust oversight in regulating the offshore drilling activities offshore Newfoundland. Chevron has drilled over 300 wells without incident and they were confident that the Lona O-55 would be completed without incident. Chevron undertook some 30 additional measures over and above the regulations to ensure the well was completed safely. These measures are discussed thoroughly in Section 3.4. The Chevron Lona O-55 exploratory well was successfully completed on August 26, 2010.

It is too early to speculate on any possible changes until the investigation into the Macondo blowout is completed. Until the investigations are concluded we won't know whether the disaster was a result of a systemic weakness in the applied technology of deepwater drilling or whether it was a one-off event.

Some changes may include increased insurance costs for deepwater wells, higher security deposits for response and clean up, re-evaluation and possible re-engineering of blowout preventers, well barriers, increased audits, reporting and inspections, etc.

Indeed the C-NLOPB has, since the Macondo incident, tightened its monitoring and reporting procedures for the Chevron well.

Operators and regulators must ensure that the industry is operating with strict adherence to safety and within the safe operating practices of internationally recognized standards.

Section 3 - Oil-spill Prevention in Newfoundland and Labrador Offshore Installations

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3.0 Oil-spill Prevention in Newfoundland and Labrador Offshore Installations

3.1 Canada-Newfoundland and Labrador Offshore Petroleum Board

Created in 1987 through the Atlantic Accord, the C-NLOPB is the joint federal-provincial regulating body authorized to oversee all aspects of the Province's offshore petroleum industry. Their mandate is to interpret and apply the provisions of the *Atlantic Accord and the Atlantic Accord Implementation Acts* to all activities of operators in the Newfoundland and Labrador Offshore Area and to oversee operator compliance with those statutory provisions (C-NLOPB, 2010). The Board operates as an independent organization and reports to the Minister of Natural Resources for both the Federal and Provincial Governments. The Board currently has over 600 years of combined experience in offshore oil and gas.

The C-NLOPB regulatory mandate covers four areas: safety, environmental protection, resource management and industrial benefits. Its role in the implementation of this mandate is to facilitate the exploration and development of the petroleum resources such that it conforms to the legislated statutory provisions. This includes worker safety, environmental protection and safety, effective management of land tenure, maximum hydrocarbon recovery and value and Canada/Newfoundland and Labrador benefits (C-NLOPB, 2010). Prioritization of the mandates is not within the legislation, but the C-NLOPB has taken the initiative to ensure worker safety and environmental protection take precedence.

Safety within the offshore is accomplished through strict oversight into all operator safety procedures. This includes verifying operators have effective safety plans, performing audits and inspections to ensure operators follow these safety plans and all applicable statutory requirements, and ensuring through compliance actions that digressions from approved plans and applicable statutory requirements are corrected (C-NLOPB, 2010).

Environmental protection is an essential element of the Board's mandate. The C-NLOPB's objectives also verify that operators assess and provide for all effects of the environment on the safety of their operation. Operators must also provide detailed environmental assessments in agreement with Canadian regulations concerning the impact of their operations on the environment. In addition, plans must provide for mitigation measures where appropriate. The C-NLOPB will also verify, through compliance actions, that operators abide by their environmental plans (C-NLOPB, 2010).

The final objectives of the C-NLOPB deal with resource management and Government benefits. The Board regulates exploratory licenses, significant discovery licenses and production licenses for the entire Newfoundland and Labrador offshore. This administration of land tenure is performed in an effective and

efficient manner. The Board oversees all production activities to ensure maximum recovery and effective oilfield practice. This includes production monitoring and plan approvals. The Board also expands the knowledge base of the Newfoundland and Labrador offshore via the acquisition of data from exploratory and production activities. Finally, the Board verifies that operators have approved Canada/Newfoundland and Labrador Benefits Plans addressing their statutory obligations (C-NLOPB, 2010).

The safety of workers and the environment is the ultimate responsibility of the operators. The C-NLOPB is not responsible for the management of reservoirs and production related activities. The operators hold this responsibility within the context of an approved development plan. The C-NLOPB also plays no role in guaranteeing the participation of Canadian or Newfoundland and Labrador workers and business, nor do they have any role in the establishment or administration of the fiscal regime. Unlike some countries, the Board has absolutely no part in the establishment or administration of royalties or taxes for any offshore activity. The Board does not promote industry. That is the role of Governments. Their role is solely one of regulatory oversight of Operator activity.

The Atlantic Accord legislation defines a Chief Safety Officer with broad powers and responsibilities for worker safety, as well as a Chief Conservation Officer with powers over resource management. The legislation stipulates that an order made by the Chief Safety Officer cannot be overruled by the Board, and it prevails over a decision of the Chief Conservation Officer. In short, the Atlantic Accord legislation provides that in matters of safety versus resource management and production, safety is paramount. The Board provides required data and information to Government.

Detailed information regarding the current capabilities and practices of the C-NLOPB is described throughout this report. General information regarding requirements to drill a well and achieve Operations Authorization is provided in Table 1.

There is a requirement for a minimum of two tested and qualified barriers to well production at all times, and there are specific requirements for the BOP and for the riser. Requirements also include documentation of the potential effects of accidental events, including blowouts. A typical spill assessment includes trajectory model results.

Table 1 - C-NLOPB Requirements Prior to Drilling

Requirements for an Approval to Drill a Well	Requirements for Operators Authorization
<ul style="list-style-type: none"> • Formation pressure and fracture gradient evaluations • Barrier analysis to confirm two barriers at all times • Casing program • Cementing program • Drilling fluids • Casing and wellhead pressure testing • Formation leak-off tests • Blowout preventer (BOP) configuration • BOP pressure and function testing 	<ul style="list-style-type: none"> • Safety plan • Environmental assessment • Environmental protection plan • Contingency plans • Offshore and onshore-emergency response plans • Oil-spill response plan • Ice management • Relief-wells • Certificate of fitness • Operator's declaration of fitness • Letter of compliance • Financial responsibility • Canada-Newfoundland and Labrador benefits plan

Source: (C-NLOPB, 2010)

3.2 General Prevention Measures in Newfoundland and Labrador

General information on oil-spill prevention is provided in Appendix IV. Much of this information is applicable worldwide throughout the oil and natural gas industry, covering topics which include oil-spill sources, causes and frequency, general spill prevention measures, and Canada-wide regulatory regimes.

This section looks to elaborate upon this information with general information applicable to the Newfoundland and Labrador offshore industry. Section 3.3 dives deeper within the specific prevention measures, outlining the approval process to drill in the Newfoundland and Labrador offshore.

3.2.1 Regulations

Numerous regulatory requirements are imposed by the C-NLOPB, either through direct provisions of the Atlantic Accord or other legislation. These regulations impose the actions that operators must follow in order to proceed with their planned activities. The regulatory requirements cover all components of an operation in the context of the C-NLOPB's defined mandate under the Atlantic Accord. Section 3.3 details the regulatory requirement as they relate to the current capabilities and practices in Newfoundland and Labrador. Table 2 lists relevant legislation pertaining to Operations Authorizations.

3.2.2 Well Design and Well-control

BOP Specific Requirements

The C-NLOPB has numerous requirements pertaining to BOP's. The requirements govern details concerning stack configuration and operating limits. Capacity and redundancy within the BOP control system is also investigated. The C-NLOPB also dictates pressure and function testing procedures and frequency. The verification of these tests is achieved through daily report information and record reviews during audits and inspections. The number of modes of activation is also set by the Board. For anchored vessels in shallow water, one of three backup systems is required. For dynamically positioned vessels in deepwater two of three backup systems are required.

Riser Specific Requirements

A riser in drilling operations refers to the well extension from the wellhead to the surface facility. Risers may pose a threat in terms of a spill should they disconnect or break. In some situations, such as "drift off" of the platform, it is desirable that the riser breaks off as opposed to the wellhead to limit the amount of oil-spilled. The C-NLOPB has several riser specific requirements, including drill site-specific riser analysis, weak-point assessments, emergency and planned disconnect procedures, and "drift off" management.

Table 2 - Authorizations and Approvals Involved in Operations Authorization

Area	Relevant Legislation
Drilling program	Section 11 of the Newfoundland and Labrador Offshore Petroleum Drilling and Production Regulations
Production operations	Section 7 of the Newfoundland and Labrador Offshore Petroleum Drilling and Production Regulations
Well operations	Section 10 of the Newfoundland and Labrador Offshore Petroleum Drilling and Production Regulations
Vertical seismic profile programs	Section 138 of the Canada-Newfoundland Atlantic Accord Implementation Act
Wellsite seabed surveys	Section 138 of the Canada-Newfoundland Atlantic Accord Implementation Act
Safety Plan	Section 8 of the Newfoundland and Labrador Offshore Petroleum Drilling and Production Regulations
Training Plan	Section 72 of the Newfoundland and Labrador Offshore Petroleum Drilling and Production Regulations
Environmental Protection Plan - Production	Section 9 of the Newfoundland and Labrador Offshore Petroleum Drilling and Production Regulations
Field Data Acquisition Program	<ul style="list-style-type: none"> • approval of field data acquisition pursuant to Section 49 of the Newfoundland and Labrador Offshore Petroleum Drilling and Production Regulations • approval of the formation flow testing pursuant to Section 52 of the Newfoundland and Labrador Offshore Petroleum Drilling and Production Regulations
Additional approvals including approval to pre-drill development wells (to the conductor or surface casing point), approval to terminate (complete) development wells and approval of certain well operations	

Source: Modified from (C-NLOPB, 2010)

3.2.3 Facility Design

Facilities in the Newfoundland and Labrador offshore are designed with safety for workers and the environment as the number one priority. Many safeguards are incorporated into the platform safety design, including process shutdown/emergency shutdown functions based on distributed control systems, emergency control systems and emergency shutdown valves, pressure safety valves and flare relief systems, process instrumentation, fire and gas detection, fire suppression and blast walls (HMDC, 2010).

Several components of the facilities are designed to manage oil and prevent spills. Spills may result from several aspects of an operation. These may be categorized into produced water handling systems, platform drain systems, impacts from icebergs or ships, ballast water discharges or a riser release.

Produced water is water produced with oil and gas. As a field's life progresses, significant volumes of water are produced. Oil must be removed from the water prior to discharging the water to the ocean. All produced water on a production facility must be treated to the desired effluent specifications outlined in the C-NLOPB Offshore Waste Treatment Guidelines (OWTG). The entrained oil is removed in three

stages. First, primary separation is achieved through oil-water separators. These devices work on the principle of gravity segregation. Next, secondary treatment is achieved through hydro-cyclones. These devices use centrifugal forces to separate the oil from water. Finally tertiary separation is achieved through degasser vessels. These systems are equipped with instrumentation and controls to continuously monitor levels to ensure they are within the required limits. Should levels exceed the limits, alarms will activate and process shutdowns or emergency shutdowns may occur.

Oil residue from platform operations and equipment at the topside facilities of Hibernia and the decks of the remaining facilities must be collected in platform drainage systems. These are designed to collect liquids drained from equipment and wash-downs to prevent them from directly entering the ocean environment. The process drains are routed to oily water treatment systems. These consist of centrifugal devices similar to that of the produced water system. The C-NLOPB limits the concentration of effluent from these systems to less than 15 mg/L of oil in water prior to disposal, as per the requirements set out by the OWTG.

A unique design consideration for Newfoundland and Labrador is the prevalence of seasonal sea-ice and icebergs. These pose a significant threat to production operations and therefore play critical roles in the concept design. The Hibernia platform is a concrete gravity-based structure (GBS) consisting of a 15 metre thick ice-wall and 16 ice teeth. The exterior of the wall is approximately 1.5 metres wide, with the remainder being an open-web structural system. The platform is designed to withstand the direct impact of a 1 mega-tonne iceberg without sustaining critical damage. Figure 6 shows the construction of the ice wall. In the figure, the open web structural system is clearly visible, with the construction buildings placed on an overhang along the exterior wall. Figure 7 is another construction photo showing a profile view of the same operation.

The remaining FPSO operations are designed with a turret mooring system allowing for a safe disconnect from the risers to avoid collisions with icebergs. The vessels are also ice strengthened and double hulled to mitigate potential damage. Ice conditions are constantly monitored through radar systems having enhanced target acquisition and tracking capabilities as well as air and boat surveillance during the peak season. In addition, supply vessels are kept nearby to tow or deflect icebergs encroaching upon the platforms. Figure 8 is a photo of an ice-towing operation in the Newfoundland and Labrador offshore.



Figure 6 - Plan View of the Hibernia GBS Ice-wall Construction

Source: Acquired from Dr. S. Bruneau

Crude-oil export lines are used to transport oil from the production facilities to nearby tankers. These lines are made of heavy steel and concrete, and have the ability to be flushed in the event of potential damage from encroaching ice. These lines are also equipped with fail-safe coupling valves should a collision occur.

Tanker and ship collisions also pose a threat to the offshore installations. Oil within the GBS is protected by the 15 metre thick ice wall, while the FPSO's are designed with double hulls to reduce the likelihood of a spill from collisions. As well, tankers must maintain position within a confined circle. If they go beyond these limits loading operations will automatically shutdown. All facilities have a defined safety zone around them as designated by Transport Canada and the C-NLOPB. No vessels are allowed within these limits (HMDC, 2010).

Ballast water is used at the Hibernia GBS as well as both FPSO's. At Hibernia, it is used in storage and loading operations to maintain the pressure in the storage cells by keeping them full of liquid. For the FPSO's, this technique is also used to provide stability. The levels of ballast water are continuously monitored. Should the levels exceed their given limits emergency shutdown devices will trigger a production shutdown.



Figure 7 - Profile View of the Hibernia GBS Ice-wall Construction

Source: Acquired from Dr. S. Bruneau

The FPSO operations require additional measures for production due to exposed subsea wellheads and risers. Manifolds containing groups of wellheads are placed in glory holes excavated on the sea floor to protect them from potential collisions with scouring icebergs. Whereas the platform itself can move to avoid collisions, the subsea well equipment cannot, making this additional measure necessary in iceberg-predominant waters. Risers are designed to be flexible to allow for safe disconnects from the platforms. They also undergo weak-point assessments to ensure that should a collision or “drift off” occur, the riser will break prior to the wellhead, limiting the volume of oil-spilled. The flow-lines can also be quickly flushed with seawater to prevent spills in the event of a collision (CAPP, 2006).



Figure 8 - Ice-towing Operation

Source: (Canadian Association of Petroleum Producers, 2006)

3.2.4 Facility Operation

Safety management is critical during the operation of a production facility in the Newfoundland and Labrador offshore. Numerous regulations are set in place by the C-NLOPB to ensure operators perform in a safe manner. Critical components include the Operations Safety Plans (OSP) as well as the operators Safety Management Systems (SMS).

Operations Safety Plans

As part of the Operations Authorization, operators must complete detailed safety plans formalizing their commitment to safe and environmentally sound work practices. The plans are based upon the initial concept safety plans. They must be frequently updated to reflect operational changes within the operations. Updates of the plan are required every three years as part of the Operations Authorization. The plan lays out the framework for which operations will be conducted at a facility. These plans must be approved by the C-NLOPB prior to implementation. Audits completed by the C-NLOPB and the Certifying Authority use the safety plan as its basis (HMDC, 2010).

Safety Management Systems

Safety management systems outline systematic processes to manage risk at an operation. Their goal is to identify hazards and mitigate or eliminate their associated risk. Typical safety management systems include integrated organizational structures, responsibilities, accountabilities, policies, procedures, as well as measurements, feedback and continuous improvement processes (HMDC, 2010).

Hibernia's safety management system is entitled Operations Integrity Management System (OIMS). OIMS is a systematic and structured approach to handling safety, health, environment and security within all aspects of the Hibernia operation. The system is based upon hazard identification and risk management. It is implemented worldwide throughout numerous ExxonMobil operations. The system involves a high level of management involvement and accountability. It enforces all safety and environmental policies agreed to in the regulations and Operations Authorization. Workforce participation is an important aspect of OIMS effectiveness and the process is integrated into all operations and work related activities. Whereas OIMS is strictly a policy of HMDC, all operators have similar forms of safety management systems. Figure 9 is a schematic of the various elements of OIMS.

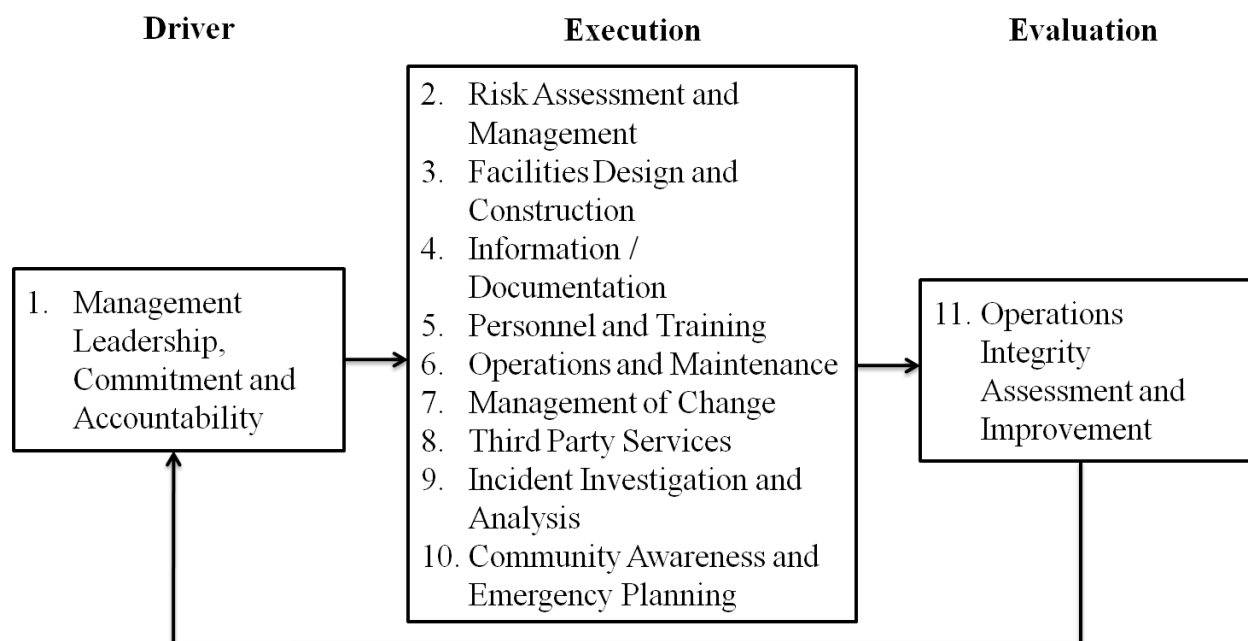


Figure 9 - HMDC's Operations Integrity Management Systems

Source: (HMDC, 2010)

3.3 Approval and Regulatory Process in Newfoundland and Labrador

The Newfoundland and Labrador offshore oil and gas industry is highly regulated. The C-NLOPB ensures a safe work environment through detailed regulations and guidelines, work authorization requirements, fitness for services verification through certifying authorities, continuous monitoring, quarterly audits and compliance assessments. The following sections outline the C-NLOPB's regulatory requirements, operational oversights, various equipment specifications and additional measures taken for the recent Chevron Lona O-55 deepwater well.

3.3.1 Regulatory Requirements

The C-NLOPB requires operators to submit an assortment of plans for approval prior to obtaining authorization for exploration, development and production. These plans are designed to align with the Boards mandate to address safety, environmental protection, resource management and industrial benefits. Approvals may involve the approval of specific documentation, plans, or other regulatory requirements, or may be covered under the authorization of specific activities.

3.3.2 Regulatory Approval for Operator Installations

Prior to the authorization of an operating installation, numerous plans must be submitted, reviewed and approved by the experts at the C-NLOPB. These plans evaluate the entire spectrum of a proposed operation. They are implemented and reviewed to ensure operational plans coincide with the goals outlined in the C-NLOPB mandate. Several of the most critical elements include a Development Plan, Canada-Newfoundland and Labrador Benefits Plan and a Reservoir Depletion Plan. As well, as part of the initial Operations Authorization, a Concept Safety Analysis is required. Further information regarding Operations Authorization and other safety related plans are detailed in the next section.

3.3.3 Regulatory Approval for Drilling Programs

The Board's oversight of an offshore drilling operation commences at the early planning stage, typically 18 months prior to a proposed program. This is a key step to ensure prospective operators are aware of the various statutory and regulatory requirements. It ensures these matters can be taken into account throughout the contracting and procurement phases. This is important for the acquisition of long-lead items that affect the safety of the operation.

The regulatory approval process for drilling programs involves a two-tier process. First, authorization of the overall drilling program must be achieved through an Operators Authorization (OA). Second, a well approval for an individual well must be obtained in the form of an Approval to Drill a Well (ADW) as

part of the drilling program application. These two approvals, as well as the Strategic Environmental Assessment are described below.

3.3.4 Strategic Environmental Assessment

The Strategic Environmental Assessment (SEA) is the first environmental assessment carried out for any potential operation. The assessment is carried out by the Board before exploration licenses are issued or before drilling programs are contemplated. The SEA is a measure, taken in part with public consultation that goes beyond that required by the Accord legislation and the federal environmental assessment legislation. The SEA is essentially an overview of potential impacts associated with potential development. This is not a project-specific assessment, but it does include considerations for potential blowout risk and fate. The assessments identify mitigating measures for the environmental risk identified. These measures are included in the Operations Authorization for greater certainty with respect to the legal obligation of the operator to abide by these requirements (C-NLOPB, 2010).

3.3.5 Tier 1 - Operations Authorization (OA)

An Operations Authorization allows the operators to combine several activities into a single application in which the activities are similar or will be conducted in sequence. These include drilling operations, production operations, well operations and other relevant activities. An Operations Authorization is issued by the Board to an operator. It is approved every three years providing a number of statutory obligations are met. Relevant regulatory approvals within the context of the operations authorization include a Project-Specific Environmental Assessment, a Certificate of Fitness, an Operator's Declaration of Fitness, a Letter of Compliance from Transport Canada, Safety Plans, an Environmental Protection Plan and Contingency Plans.

Project-Specific Environmental Assessments are conducted under both the federal *Canadian Environmental Assessment Act* and the Accord legislation. The assessment includes the preparation of a detailed technical report that investigates the effects the operation may have on the environment as well as the effect the environment may have on the operation (i.e. wind, waves, ice, etc). Elements of the assessment include consultation with potentially affected parties, including fishermen. All documents produced in the environmental assessment are extensively reviewed by experts at the C-NLOPB as well as Federal and Provincial Government departments. The documents are publicly available on the C-NLOPB website.

Operators must obtain a Certificate of Fitness from an independent third party certifying authority as required by both the Act and regulations. Only four organizations are approved by the Board to act as a certifying agent: The American Bureau of Shipping (ABS), Bureau Veritas, DetNorske Veritas

Classification A/S (DNV) and Lloyd's Register of Shipping (LR). The certifying authority reviews all installations of an operation to ensure they are safe for use, working as intended and meeting the requirements set out in the regulations. The certificate of fitness is required before installations can be used to conduct any activity in the offshore jurisdiction. The ultimate responsibility in terms of safety and compliance with regulations lies in the hands of the operators. The purpose of the independent third party is to ensure and verify all mandatory requirements are being met and the operation is abiding to safe practices. Note the certification explicitly includes the BOP stack and other relevant components of well-control (C-NLOPB, 2010).

The scope of work to be performed by the certifying authority requires the approval of the Board, specifically the Chief Safety Officer. The scope addresses maintenance, inspections and testing of the facilities and equipment. Surveys are conducted prior to installation as well as periodically throughout to ensure integrity is maintained. Any modification of repairs that may affect strength, stability, integrity, operability, safety or regulation compliance must be reviewed and approved by the certifying authority to ensure the issued certificate remains valid. If the certification loses its validation the Operations Authorization also becomes void, effectively halting all planned, proposed or ongoing activities.

3.3.6 Letter of Compliance

As part of a Memorandum of Understanding between the C-NLOPB and Transport Canada, a Letter of Compliance is required verifying compliance to the MODU code for any foreign-flagged drilling installations. The *Canada Shipping Act* only requires these measures for Canadian-flagged vessels. Through this letter of compliance, the Board ensures all vessels, Canadian or foreign, follow the measures of the code. This provides an additional measure of marine safety with the Certificate of Fitness (C-NLOPB, 2010). The letter ensures the compliance of all vessels, Canadian or foreign, to the *Canadian Shipping Act* and the Mobile Offshore Drilling Unit (MODU) code. The Canadian standards respecting the MODU code are:

1. Recognizing that some present domestic regulations do not refer specifically to Mobile Offshore Drilling Units (MODUs), the Canadian Coast Guard (CCG) has adopted the following Standards for the design, construction and operation of new Canadian registered MODUs pursuant to paragraph 37(2)(a) of the *Canada Shipping Act*. Existing Canadian-registered MODUs shall comply with these Standards to the extent considered reasonable and practicable by CCG.
2. The Standards have been based upon the International Maritime Organization's (IMO) *Code for the Construction and Equipment of Mobile Offshore Drilling Units*. A position has been defined for those areas in the IMO's Code where the level of safety is delegated to the Flag

Administration. Additional requirements have also been included in the Standards that have not been specifically addressed in the IMO Code. These Standards are considered equivalent to the technical requirements of the *International Convention for the Safety of Life at Sea, 1974* and the *International Convention on Load Lines, 1966*.

3. The Standards do not include requirements for the drilling of, or the procedures for control of, the subsea well. Notwithstanding that foreign-drilling operations are subject to the control of the Coastal State, Canadian-registered MODUs should comply in general with the *Canada Oil and Gas Lands Administration (COGLA)* drilling equipment requirements.
4. Recognizing CCG's responsibility under the terms of the CCG/COGLA Memorandum of Understanding, all foreign-registered MODUs operating on Canada Lands shall comply with these Standards as if they were Canadian-registered units.

The Standards may be cited as the MODU Standards and contain the following parts:

1. General
2. Construction, Strength and Materials
3. Intact and Damage Stability and Freeboard
4. Machinery Installations for all Types of Units
5. Electrical Installations for all Types of Units
6. Machinery and Electrical Installations in Hazardous Locations for all Types of Units
7. Machinery and Electrical Installations for Self-Propelled Units
8. Periodically Unattended Machinery Spaces for all Types of Units
9. Fire Safety
10. Life-Saving Equipment
11. Radio Communication Installations
12. Lifting Devices
13. Helicopter Facilities
14. Operating Requirements

3.3.7 Additional Operations Authorization Requirements

Additional regulatory requirements, as part of the operations authorization, include environmental protection plans, safety plans and contingency plans. The environmental protection plan details how production-related activities will be handled to mitigate damage to the surrounding environment. Details regarding these measures are found in the Newfoundland Offshore Petroleum Production and Conservation Regulations. Specific topics include the use of spill countermeasure chemicals, disposal of sewage, galley or other domestic waste, disposal of waste fluid and drill cuttings and the disposal of spent acid (C-NLOPB, 2010).

Safety Plans are an important component of the existing regulations. Operators must provide a detailed report specifying how safety-related items will be managed. These plans include hazard identification, risk management, training and competency of personnel, details of systems and equipment (including maintenance, inspection and testing), operating procedures and processes, a Joint Occupational Health and Safety Committee (JOHSC), incident reporting and investigation, management oversight and monitoring, etc.

In addition to Safety Plans, a Contingency Plan is required to act as a preliminary plan of action in the event of a spill or significant incident. The contingency plan covers numerous areas of concern with respect to safety. Several of the plans covered within the scope are Offshore and Onshore Emergency Response Plans, Oil-spill response Plans, Ice Management and Relief-wells. Contingency plans are now publicly available from the C-NLOPB.

Operation Authorization also requires the submission of documentation regarding financial responsibility, including the Canada-Newfoundland and Labrador Benefits Plan. These documents contain details with respect to payments, royalties, etc.

The final document required for authorization is the Operator's Declaration of Fitness. In this declaration, the operator must attest to a safe and reliable operation. This includes all equipment and facilities being fit for purpose, having appropriate operating procedures for the use of such equipment and having competent employees that are qualified in their roles and will remain so throughout the duration of the authorization (C-NLOPB, 2010). As part of the authorization process, the operator must demonstrate that the requirements are being followed and will continue to be followed. If the Board is not satisfied with the operator's demonstration, they may reject the application.

3.3.8 Tier 2 - Approval to Drill a Well

The second-tier process for drilling involves an Approval to Drill a Well (ADW). This approval is required for each well drilled in the Newfoundland and Labrador offshore. The ADW must provide

detailed information regarding the planned drilling program. This includes well design, equipment specifications and geological prognosis.

The ADW application requires identification and discussion of drilling-related hazards, with special emphasis on well-control and blowout prevention. Geological targets, depth, expected temperature and pressure conditions must be identified. Descriptions of the casing and cementing programs are required, as are the casing design, casing and wellhead pressure-testing program, drilling-fluid program, directional drilling and survey plans, formation pressure and fracture gradient evaluation, formation leak-off test, BOP configuration, and information regarding pressure testing and function testing of well-control equipment. The application is reviewed by a multi-disciplinary team of experts at the C-NLOPB.

The Board provides guidelines for drilling and production, which focus on critical matters with respect to well-control and blowout prevention. The guidelines reflect high standards and modern thinking in the areas of drilling, cementing and well-control matters. These guidelines can be updated to incorporate lessons learned to improve upon the current standard.

Other important approvals having similar guidelines include Approvals for Well Operations (AWO), Approval to Terminate a Well, and Approval of a Formation Flow-Testing Program. These all involve well operation and are evaluated in a similar matter as the ADW to ensure safety in the operation procedure.

3.3.9 Operational Oversight

As set out in legislation, the C-NLOPB is responsible for the implementation and enforcement of the provisions of the Act and the regulations made under it. This is accomplished through auditing, compliance monitoring, scheduled inspections and investigations. The goal is to ensure operators comply with all regulatory requirements, including the conditions imposed by the Operations Authorization (HMDC, 2010).

Oversight of the Operation Authorizations is accomplished through the Board's Safety Assessment System. The system includes a comprehensive checklist addressing all key regulatory elements and requirements. Features of the checklist include an extensive review of the operator's safety management system as well as ensuring hazards have been identified. Measures must be put in place to reduce their risk to levels considered as low as reasonably practicable (C-NLOPB, 2010).

The Chief Safety Officer has the authority to shut down any operation considered to be working with unsafe practices. The Safety Officers are responsible for ensuring operators comply with safety requirements and assessing the effectiveness of operator's management systems. Tools used to

accomplish this include compliance monitoring, safety audits and inspections, orders to comply and investigations of incidents (C-NLOPB, 2010).

Safety audits are systematic evaluations of all aspects of an operation to assess the compliance with regulatory and safety requirements. The audits may include: review of documentation, personal interviews, verification of information reported to the C-NLOPB, inspection of equipment and processes, observations of operations and verification of qualification and training of personal. Audits are performed on an annual basis.

Once an audit report is issued, an operator has 1 working day to take action on non-conformance issues. Failure to comply may result in an order to comply, or at worst will result in an offence under the Act. The order to comply directs an operator to correct an issue that may constitute an offence if left uncorrected (HMDC, 2010).

Safety inspections are undertaken as part of a safety audit, but may also be performed independent of an audit. The inspections involve the physical presence of a Safety Officer at the operation and are used to verify an operation's compliance with regulations, but are not associated with verification of fitness. Inspections take place on a quarterly basis, with ad hoc inspections taking place when required.

Operators typically investigate all incidents that occur during operations and submit a report to the Board. In certain circumstances, the Board itself may conduct an investigation into any occurrence as dictated by legislation, or it may advise the operator to do so. Investigations may also result in the Board being unsatisfied with the operator's investigation report. In the event of a Board investigation, the Chief Safety Officer or Chief Conservation Officer will notify the operator, request immediate transportation to the operation and order that the scene of the incident be preserved. Investigations may require the involvement of other agencies; including the Canadian Coast Guard, the Newfoundland and Labrador Department of Government Services, the Royal Canadian Mounted Police, the office of the Chief Medical Examiner, Transportation Accident Investigation and Safety Board, Transport Canada and Environment Canada (C-NLOPB, 2010).

With respect to drilling operations, oversight begins at the operations application level approximately 18 months prior to a proposed operation. Approval for a drilling operation involves an Operations Authorization and an Approval to Drill a Well. These applications are reviewed carefully by the Board's technical staff to ensure they meet all regulatory requirements. Once drilling operations commence, operators are required to submit daily drilling, geological and log reports. These are reviewed by the C-NLOPB staff and are provided to the Newfoundland and Labrador Department of Natural Resources for Exploration and Delineation Wells. In addition, audits and inspections occur on an ongoing basis.

3.4 Chevron Deepwater Well - Additional Measures

3.4.1 *Stena Carron* Deepwater Drillship

The *Stena Carron* is an ultra-deepwater drillship that was used to drill the Lona O-55 exploratory well in the Orphan Basin for the Chevron-led partners. The ship has the capability to drill in water depths of 3 000 metres and can drill to total depths of greater than 10 500 metres. The ship is 228 metres long, has a variable deck load of 15 000 tonnes, and has a maximum crew capacity of 180 people. It is equipped with three backup systems for BOP activation, including an acoustic system, auto-mode function and ROV intervention. Figure 10 shows a picture of the *Stena Carron* drillship, whereas Figure 11 shows a picture of the BOP stack as well as its corresponding configuration.



Figure 10 - *Stena Carron* Drillship

Source: (C-NLOPB, 2010)

3.4.2 Additional Measures for the Lona O-55 Exploratory Well

In light of the Macondo blowout, the C-NLOPB took extra precautions with respect to the Lona O-55 deepwater well drilled by Chevron. Following a disaster such as this, it is prudent for a regulator to review its measures and enhance its practices to address heightened concerns surrounding the risk of deepwater drilling. Several additional measures were set into place by the Board, with Chevron agreeing to conform to all requirements of the new oversight. Traditional measures still applied, including all aspects of the Operations Authorization, Approval to Drill a Well and conventional drilling oversight.

An oversight team was established at the Board consisting of the Chief Safety Officer, the Chief Conservation Officer, members of the Board's staff as well as senior staff with extensive drilling-related experience. The purpose of the team was to provide regulatory oversight for the Chevron operation.

Chevron provided daily reports such that the team had up-to-date information on all drilling and operation activities. Chevron also met with the C-NLOPB oversight team every two weeks to review matters of interest.

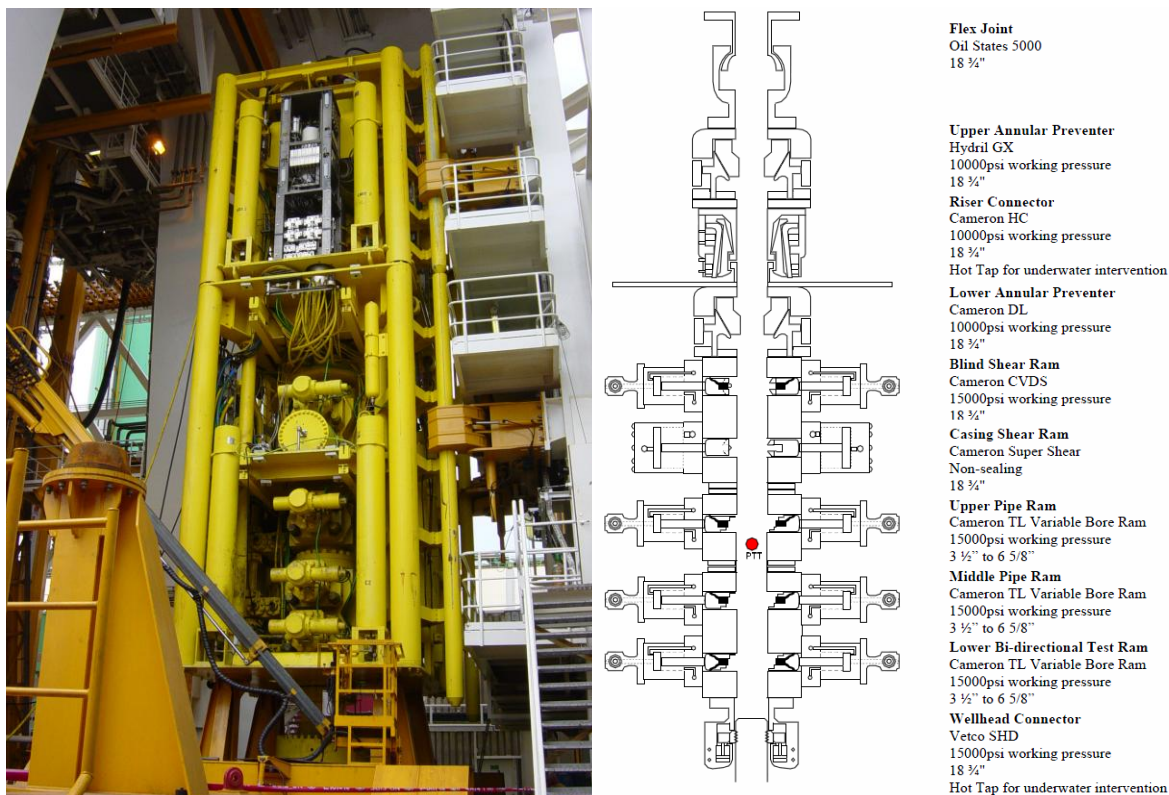


Figure 11 - Stena Carron BOP Stack and Technical Configuration

Source: (C-NLOPB, 2010)

Field reports were provided by Chevron to the C-NLOPB's well-operations engineer. These reports contained details on testing activities aboard the drillship. These included pressure testing of the BOP stack, function testing of the backup systems (acoustic controller, automode function system and ROV intervention), and an assessment of the readiness of an ROV system with respect to equipment, procedures and spare parts (C-NLOPB, 2010).

As part of the requirements, Chevron also monitored the Macondo developments to incorporate any lessons learned as a result of the ongoing investigation. They provided the Board's oversight team with periodic assessments of how any lessons learned may have pertained to the Lona O-55 operation. In particular, issues with respect to well operations, BOP equipment and spill-response were critical. In addition, the audit and inspection frequency of the operation was increased to every three to four weeks, as opposed to the traditional three to four months.

Prior to penetrating a target formation, the operation had to take an operations time-out. During this time they reviewed and verified that all appropriate equipment, systems and procedures were in-place to allow for a safe and successful operation without harm to individuals or the environment. This was performed to the satisfaction of the Chief Safety Officer or Chief Conservation Officer. Chevron also assured itself and the Board that all spill-response equipment was available for rapid deployment in the event of an incident.

The additional oversight included that a C-NLOPB observer must be on board at certain times during the drilling process. The observer witnessed the cementing operation for the last casing string prior to entering a target formation. The observer also witnessed BOP testing, well-control drills and the pressure-testing results of the cementing job. In the case of BOP test, a member of the Certifying Authority was also present (C-NLOPB, 2010).

Finally, prior to well termination, Chevron provided the Board's oversight team with a copy of the planned termination program. The team reviewed and assessed this document to ensure a safe operation. A C-NLOPB representative was also onboard to observe this process.

For further information on the C-NLOPB well-control procedures, please refer to Appendix V - Background on the Regulatory Regime for Subsea Well-control and Oil-spill Readiness and Response. In addition, several valuable presentations have been included in the Appendices for further reading and clarification concerning issues of well-control, spill prevention, preparedness and response. These are as follows:

Appendix VI	Statement by Max Ruelokke P.Eng, Chair and CEO, C-NLOPB (Made to the House of Commons Standing Committee on Natural Resources on May 25, 2010)
Appendix VII	Subsea Well-control for Drilling Operations and Oil-spill Readiness (Prepared by the C-NLOPB as a Technical Briefing for Media on June 2, 2010)
Appendix VIII	Regulatory Environment, Batch-spill Sources and Facility-Spill Prevention (Prepared by Hibernia Management and Development Company and presented to Mark Turner and Justin Skinner on June 25, 2010)
Appendix IX	Spill Prevention - Well Design, Well-control and Drilling (Prepared by Husky Energy and presented to Mark Turner and Justin Skinner on June 25, 2010)
Appendix X	Oil-spill Preparedness and Response Overview (Prepared by Suncor Energy and presented to Mark Turner and Justin Skinner on June 25, 2010)
Appendix XI	ECRC-SIMEC Overview (Prepared by ECRC in June, 2010)

Appendix XII

David Pryce Presentation to House of Commons Standing Committee on Natural Resources (Prepared by CAPP and presented on May 13, 2010)

Appendix XIII

David Pryce Presentation to Standing Senate Committee on Energy, the Environment and Natural Resources (Prepared by CAPP and presented on June 22, 2010)

3.5 C-NLOPB Response to Macondo Incident Well-control Procedures

On June 14, 2010, Bart Stupak, Chairman on the U.S. Congressional Subcommittee on Oversight and Investigations, sent a detailed letter to Mr. Tony Hayward, Chief Executive Officer of BP. The letter addresses the drilling and well-control practices of BP prior to the Macondo blowout. In particular, five issues were of concern:

- The decision to use a well design with few barriers to gas flow;
- The failure to use a sufficient number of "centralizers" to prevent channeling during the cement process;
- The failure to run a cement bond log to evaluate the effectiveness of the cement job;
- The failure to circulate potentially gas-bearing drilling muds out of the well; and
- The failure to secure the wellhead with a lockdown sleeve before allowing pressure on the seal from below.

The letter states that "the common feature of these five decisions is that they posed a trade-off between cost and well safety" (Congress of the United States, 2010). The letter has been included in Appendix XIV. Please refer to it for additional detail related to these key issues.

The authors of this report requested that the C-NLOPB provide feedback to these issues in relation to how they are addressed in the Newfoundland Offshore. The following section outlines the C-NLOPB response. The words are directly from the regulator and have not been modified or edited from their original content.

3.5.1 General

"This document provides the C-NLOPB's viewpoints on the items noted in the June 14, 2010 US Congress Letter to Mr. Tony Hayward in respect to the Macondo incident in the Gulf of Mexico.

It is important to note that the matters raised in that letter are not based on the results of any formal investigation by a technical body or agency; therefore, it may not be appropriate to focus on these topics as formal findings with respect to the causes or contributing factors to the identified items of interest in the documentation, and in fact, the C-NLOPB did undertake such a review within days of obtaining a copy of the letter.

The US Congress letter noted that the committee was focusing on "five crucial decisions made by BP: (1) the decision to use a well design with few barriers to gas flow; (2) the failure to use a sufficient number of

"centralizers" to prevent channeling during the cement process; (3) the failure to run a cement bond log to evaluate the effectiveness of the cement job; (4) the failure to circulate potentially gas-bearing drilling muds out of the well; and (5) the failure to secure the wellhead with a lockdown sleeve before allowing pressure on the seal from below."

Commentary to each of these items is noted below; however, it is useful to first provide some general statements in respect to the regulations, guidelines and approvals for drilling operations.

3.5.2 Drilling and Production Regulations

The Drilling and Production Regulations are performance-based, which is a mixture of goal-based and prescriptive requirements. These regulations are supplemented by guidance, which contain a description of the Board's expectations and which references standards such as NORSOK, API, IADC, ISO, etc. Throughout the Drilling and Production Regulations and Guidelines, there is a significant focus on well design, well-control, blowout prevention and well-bore security. The current guidelines take into consideration the expectations that existed in the prior prescriptive Drilling Regulations and that have been applied consistently in the C-NLOPB's jurisdiction. They also take into consideration expectations in other regulatory regimes, with particular attention to the North Sea practices. Finally, they take into consideration good industry practice that has been observed within the C-NLOPB's jurisdiction.

As an example, in respect to well integrity, the NORSOK Standard D-010 is referenced in the guidelines as a standard that may be used in respect of well-barrier elements, and well-barrier envelopes, to ensure well integrity throughout the various phases of drilling, completion, production, workover and well-intervention operations. We consider this standard, and the concept of well-barrier envelopes, to be best practice and refer to it on a regular basis when reviewing matters of well integrity and barrier management.

Another example is the requirement within regulation and the standard industry practice that the drilling fluid is a key barrier in maintaining primary well-control. Current drilling practices and procedures offshore NL are such that the drilling fluid densities are usually significantly higher than what would be required to maintain an adequate overbalance to formation pressures as a result of the need to assure well-bore stability. This factor, combined with the use of prudent drilling practices, proper well-bore and drilling fluid surveillance and abnormal pressure detection procedures are key elements to kick prevention. Reducing the frequency of kicks will reduce the likelihood of a blowout.

Within our regulatory regime, Operator's plans, policies and procedures are assessed against the regulations and the guidance during the review of the Operations Authorization (OA) application. An OA is required before an operator can undertake any activity in the offshore Newfoundland jurisdiction. In

respect to drilling operations, in addition to an OA, the regulations require an operator to obtain an Approval to Drill a Well (ADW) for each well that is to be drilled. The Drilling and Production Guidelines specify that an ADW contain certain technical information as it relates to well-control, which includes but is not limited to:

- a geological prognosis - to identify shallow gas hazards
- a summary of the lithology - normally from 3D seismic
- the depth and nature of formations where problems such as lost circulation, overpressure, swelling shale or permafrost are anticipated
- pore pressure and fracture gradient profiles
- the step-by-step sequence of operations
- the well-evaluation plans (mud logging, wireline logging programs, coring, etc)
- a description of the casing and cementing program as well as details of the casing design
- the proposed casing pressure-testing program
- details of formation leak-off or formation integrity test
- the drilling fluid and solids control plans and procedures
- directional drilling and survey plans with targets identified
- a description of the well-control equipment and information respecting pressure testing and function testing well-control equipment

The C-NLOPB takes a holistic approach to considering the appropriateness of an operator's plans for conducting drilling operations. This holistic approach is based on expectations that have evolved from a combination of proven established requirements, accepted standards and good industry practice. Having provided this general commentary, the following is a summary of our comments on each of the individual issues raised by the US Congress letter.

3.5.3 Well Design

With respect to Well Design, the US Congress letter focused specifically on the choice for the final section of steel tubing in the well. The letter noted that: "BP had a choice of two primary options: it could lower a full string of "casing" from the top of the wellhead to the bottom of the well, or it could hang a "liner" from the lower end of the casing already in the well and install a "tieback" on top of the liner. The

liner-tieback option would have taken extra time and was more expensive, but it would have been safer because it provided more barriers to the flow of gas up the annular space surrounding these steel tubes.”

Typically in an offshore well, multiple casing strings are run including conductor casing, surface casing and several other strings of casing as may be needed to reach the well's total depth. A casing string may consist of a single weight and grade of casing or it can consist of several different weights and grades of pipe. In some cases, various diameter pipe is used within the same string of casing. If so, the casing string is referred to as a "tapered" string. In some cases, liners are installed in conjunction with casing. A liner is hung from the base of the previous casing string, using a liner hanger, and extends to its setting depth. A liner does not extend back to the wellhead whereas a casing string is run from the wellhead to its setting depth. In some instances where liners are run, casing is also installed from the top of the liner back to the wellhead. This portion of the string, if it is run, is known as the tieback.

For any given well, there can be a variety of acceptable designs - rarely is there only one “correct” answer. Well integrity, and the appropriateness of a proposed well-bore design, must be evaluated as a whole, by collectively considering all the well-bore elements as they interact to provide the appropriate well-barrier envelopes (refer to the NORSOK D010 standard for a review of the well-barrier envelope concept).

The C-NLOPB does not prescribe in the regulations or guidelines whether casing, liners, tapered strings or tiebacks must be used in any particular circumstance. All such strings are acceptable, provided that they meet the regulatory requirements, including the design requirements for burst, collapse, tensile and all other loads as well as the need to meet the design safety factors and that, once installed, they are pressure tested to verify their integrity as acting as a well barrier against flow. It is also imperative that the casing string or liner be cemented adequately and there are also regulatory requirements pertaining to cementing operations, the type and quality of cement that must be used as well as the minimum compressive strength requirements of the cement. All of these matters are specified in the drilling and production regulations and associated guidelines.

With respect to casing strings or tiebacks, there are also regulatory expectations pertaining to the hangers needed to lock-down the casing, as well as the seal assemblies needed to provide a gas-tight pressure seal within the wellhead. These elements must also be tested upon installation to verify that they are functioning properly and that they form an effective seal.

Neither casing, nor liners, nor liners together with tiebacks, necessarily offer a greater or lesser number of barriers against flow. The more important consideration is that the integrity of the casing, liner or tieback be verified by pressure testing; the casing hanger (or liner hanger) and seal assembly be verified by

pressure testing; and, the integrity of the cementing operation be verified by pressure testing or, in the case where zonal isolation of any hydrocarbon zones is a necessity, by also running a cement evaluation log. All of these expectations are standards that we have been enforcing consistently for all operations offshore NL and we will continue to do so in the future. These are vital considerations to ensuring well integrity and well barriers and we will not compromise whatsoever in enforcing these standards and requiring that there be a minimum of two barrier envelopes against well flow at all times as specified by the regulations.

Through the ADW application process, the operator has to demonstrate that the well design, the drilling program and the barrier integrity testing is in compliance with the regulations and in keeping with the expectations conveyed in the guidelines. The review of the ADW application involves a check of critical aspects of the well design to confirm that it is in keeping with the regulations and expectations conveyed in the guidelines. As an example, the values proposed for the various pressure tests are reviewed to confirm they meet or exceed the expectations.

3.5.4 Centralizers

With respect to Centralizers, the US Congress letter noted, “When the final string of casing was installed, one key challenge was making sure the casing ran down the center of the well-bore.” As the American Petroleum Institute's recommended practices explain, if the casing is not centered, “it is difficult, if not impossible, to displace mud effectively from the narrow side of the annulus,” resulting in a failed cement job.” The letter then focuses on the decisions that were made in respect to the number of centralizers that were run.

As is noted in the letter to BP, the use of centralizers aids in providing a uniform annulus around the circumference of the casing, which in turn helps to minimize the potential for “channelling” when displacing the cement out of the casing shoe and up the annulus. Channelling is defined in oilfield glossaries as “a flow area in the cement from inefficient cementing displacement of the drilling mud”. This definition speaks to the key objective of any cementing operation; namely, the efficient displacement of the drilling mud to allow the placement of cement that is not contaminated by drilling mud.

The use of centralizers is one aspect in maximizing the potential to efficiently and effectively displace drilling mud in advance of cement placement. Displacement of drilling mud is enhanced by any combination of the following:

- turbulent flow during the cement placement
- circulating/conditioning the mud immediately prior to the cement job

- pumping spacers in front of and behind the cement
- use of centralizers
- reciprocating or rotating the casing or liner to facilitate mud removal
- design of the cement job including computer modeling and laboratory analysis of the proposed cement rheology and properties

The Drilling and Production Regulations and Guidelines identify the expectations to design and place the cement for casing such that it provides effective support to the casing and that it adequately isolates the movement of formation fluids. Cement slurry must be designed and installed so that:

- the movement of formation fluids in the casing annuli is prevented and, where required for safety, resource evaluation or prevention of waste, the isolation of the petroleum and water zones is ensured
- support for the casing is provided
- corrosion of the casing over the cemented interval is retarded
- integrity of gas hydrate zones is protected

After the cementing of any casing or casing liner, and before drilling out the casing shoe, the operator shall ensure that the cement has reached the minimum compressive strength sufficient to support the casing and provide zonal isolation. The guidelines reference the ISO 10426/API 10A&10B standards as the Board's expectation.

It is expected that the operator will use good industry practice when designing the cement job to meet these regulatory requirements and this would include the selection and placement of centralizers as necessary. However, neither the regulations, nor the guidelines provide specific expectations on the use of any of the above noted mechanisms for enhancing the potential for a successful cement job.

3.5.5 Cement Bond Log

With respect to Cement Bond Log, the US Congress letter noted, "BP's mid-April plan review predicted cement failure, stating "Cement simulations indicate it is unlikely to be a successful cement job due to formation breakdown." Despite this warning and Halliburton's prediction of severe gas-flow problems, BP did not run a 9- to 12-hour procedure called a cement bond log to assess the integrity of the cement seal. BP had a crew from Schlumberger on the rig on the morning of April 20 for the purpose of running a cement bond log, but they departed after BP told them their services were not needed. An independent expert consulted by the Committee called this decision "horribly negligent."

It should be noted that a Cement Bond Log (CBL) will in no way contribute to achieving a good cement job. The first indication of the success of the cement job comes from the Cement Job report, which summarizes the parameters and modeling for the job and compares this against the recorded results from the actual cementing operation. This review also compares the rheology of the cement that has been circulated downhole against the rheology of cement that has been subject to laboratory analysis and testing. The cement slurry used for the lab analysis and testing is prepared from samples of cement, water and additives taken directly from the rig and subject to downhole conditions. Thus, there is a good understanding of the properties of the downhole cured cement provided there is care taken to match rheology defined by the lab and provided good cementing practice is followed to displace drilling mud and effectively place uncontaminated cement slurry. The Cement Job report will provide a lot of detail to evaluate the extent to which these objectives have been met.

The Cement Bond Log provides additional data about the cement behind casing to provide an increased level of confidence in the conclusions from the Cement Job report. Cement Bond Logs traditionally are only required:

- if there is reason to doubt the success of the cement placement
- to confirm zonal isolation of hydrocarbon bearing porous and permeable zones of different geological age/structures
- to confirm zonal isolation in any instances where it is required for resource management and reservoir purposes

Integrity of the well, for which the cement is only one element, is considered in two respects; integrity for drilling ahead and integrity for suspension/abandonment. The key indicators of the integrity of the well-bore, including the cement job, for being able to safely drill ahead, are a successful casing pressure test and an adequate Formation Leak-Off Test or Formation Integrity Test. The outcome from these pressure tests is the primary basis of determining if it is safe to drill ahead or if remedial work, such as a cement squeeze, is required before further drilling can be conducted. In respect to the integrity of the well for suspension/abandonment, it is necessary to consider the results of Log While Drilling (LWD) information, openhole wireline logging, drilling issues encountered such as loss circulation zones, and the results of the cement job. All of this information will influence the requirements for plugs that will be required in the well-bore in order to safely suspend/abandon the well. The availability of Cement Bond Logs may also provide useful information in defining the plugging program.

The C-NLOPB's guidelines for Data Acquisition Programs, define the requirements for Cement Evaluation Logs as they pertain to Resource Management. There are no specific requirements for Cement

Evaluation Logs in respect to determining the integrity of cementing from a drilling and well operations perspective. For the latter, pertinent information from the cementing reports, casing pressure tests and formation leak-off tests are used.

3.5.6 Mud Circulation

With respect to Well Design, the US Congress letter noted, “In exploratory operations like the Macondo well, wells are generally filled with weighted mud during the drilling process. The American Petroleum Institute (API) recommends that oil companies fully circulate the drilling mud in the well from the bottom to the top before commencing the cementing process. Circulating the mud in the Macondo well could have taken as long as 12 hours, but it would have allowed workers on the rig to test the mud for gas influxes, to safely remove any pockets of gas, and to eliminate debris and condition the mud so as to prevent contamination of the cement. BP decided to forego this safety step and conduct only a partial circulation of the drilling mud before the cement job.”

As is noted above in the discussion on the use of Centralizers, the key objective of any cement job is the efficient displacement of the drilling mud to allow the placement of cement that is not contaminated by drilling mud. It is also noted that there are a number of considerations to be taken into account to meet this objective. Circulating and conditioning the mud is an important activity to undertake at the start of any cement job. This greatly enhances the ability to achieve a successful cement job.

Mud circulation is required to remove drill cuttings from the well-bore and to remove background and formation gas. Mud surveillance and management is fundamental to maintaining well-control. The importance of this is stressed as part of the required training in well-control.

3.5.7 Lockdown Sleeve

In respect to Well Design, the US Congress letter noted “Because BP elected to use just a single string of casing, the Macondo well had just two barriers to gas flow up the annular space around the final string of casing: the cement at the bottom of the well and the seal at the wellhead on the sea floor. The decision to use insufficient centralizers created a significant risk that the cement job would channel and fail, while the decision not to run a cement bond log denied BP the opportunity to assess the status of the cement job. These decisions would appear to make it crucial to ensure the integrity of the seal assembly that was the remaining barrier against an influx of hydrocarbons. Yet, BP did not deploy the casing hanger lockdown sleeve that would have prevented the seal from being blown out from below.”

As required by Section 25 of the Newfoundland and Labrador Drilling and Production Regulations:

“The operator shall ensure that

(a) all wells, *installations*, equipment and facilities are designed, constructed, tested, maintained and operated to prevent *incidents* and *waste* under the maximum load conditions that may be reasonably anticipated during any operations

It is the C-NLOPB’s expectation that equipment be installed, operated and maintained in accordance with the manufacturer’s recommendations. This expectation applies to wellheads, casings, liners, tiebacks and lockdown sleeves.

In particular, it is the C-NLOPB’s expectation that casing hangers be run and secured in a manner that will ensure they conform to their stated design objectives and are capable of withstanding the maximum loads to which they will be subjected. If the manufacturer’s design requires that a lockdown sleeve be run and secured in order for the casing and casing seal to be secured in the wellhead, it is the C-NLOPB’s expectation that this be done.

Whereas the regulations and guidelines do not explicitly state that casing and casing seals are to have lockdown sleeves, it must be run and set if it is an integral part of securing the casing and casing seal to the wellhead. Lockdown sleeves are typically standard components in the types of wellheads/casings used in the Newfoundland and Labrador offshore area. These are installed as one of the final steps after the casing is cemented and before the casing running tool is released.

3.5.8 Concluding Remarks

The C-NLOPB will continue to monitor the official investigation into the root cause(s) of the Gulf of Mexico blowout with a view to identifying any improvements needed to the regulatory practices and procedures as a result of lessons learned from that incident. Where necessary, the C-NLOPB’s guidelines will be updated, and other changes will be implemented, to ensure that the regulatory practices and procedures offshore Newfoundland and Labrador are consistent with international best practices. The C-NLOPB will continue to consult with the C-NSOPB, the NEB and regulators from other jurisdictions to share best practices and lessons learned.”

3.6 Detailed Prevention Measures and Comparison of Comparable Jurisdictions

3.6.1 Introduction

The primary threat of a spill during drilling operations is well blowout, such as occurred during drilling of the BP Macondo well in the deep water Gulf of Mexico in April, 2010. Blowout is defined as the uncontrolled flow of formation fluids from a well, and constitutes a threat to the safety of personnel onboard the drilling unit, as well as representing a serious hazard to the environment. Fortunately, such an event is rare, and has never occurred in the Newfoundland and Labrador Offshore Area. Blowouts have occurred, however, in the Nova Scotia Offshore Area in the 1980s during the drilling of Shell's Uniacke G-72 and Mobil's West Venture N-91 wells.

This section deals with prevention of spills through avoidance of blowout during drilling operations on deep water wells. Blowout prevention can be considered a continuous process that begins with the design of the well and extends through selection of the mobile offshore drilling unit (MODU), to the way drilling operations are conducted on the well. It involves a team made up of the oil company holding the Approval to Drill the Well (this firm is known as the Operator), its drilling contractor and a number of specialized service contractors. The personnel that make up this team are located not only on the MODU, but also in the onshore offices of the operator and its contractors.

Comprehensive management of well control is the primary focus of this team during the entire course of the well, and it is achieved by ensuring that each member of the team, while executing his or her part of the program, uses the right procedures, has the correct training and competency for the assigned tasks, and is employing equipment and facilities that are fit for the conditions that may be encountered in the well and at the wellsite. Furthermore, the team must work seamlessly together to avoid clashes and gaps, and bridge between onshore and offshore activities, as well as between planning and execution functions.

3.6.1.1 Purpose of Review

While each Operator and its contractors have their own management systems for drilling operations, each must, as a minimum, meet minimum standards for blowout prevention laid out by the country in which drilling operations are taking place. In the Newfoundland and Labrador offshore area, this is provided in mirror legislation passed by the Governments of Canada and the Province of Newfoundland and Labrador. This legislation is administered on their behalf by the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB).

The purpose of this review is to examine the legislative framework to determine if it provides an acceptable standard for control of drilling operations such that blowout can be avoided with a high degree

of certainty in deep water wells; furthermore, this regulatory system will be compared with those of other offshore jurisdictions to demonstrate that the regulatory requirements for the Newfoundland and Labrador Offshore Area are on par with the best and most effective jurisdictions in the world.

3.6.1.2 Structure of this Review

This review will begin by first describing the well control equipment used for deep water drilling operations. The regulatory system of the Province of Newfoundland and Labrador will be described using the following sequence:

1. Outline of Regulatory System
2. Policies and Procedures
3. Well Design
4. Well Control Training and Competency

These regulatory requirements will be compared with those of Norway and the United States. These countries were selected because, to a large degree, they represent polar opposites in terms of the manner in which the industry is regulated: Norway largely employs a process of self-regulation, or “internal control” whereas the United States employs a prescriptive form of regulations that specifies equipment, operations and required competencies, but provides little guidance regarding how operations are to be managed. The UK and Australia will also be described for completeness, although the regulatory systems in these two countries are distinctly different from that used offshore Newfoundland and Labrador.

3.6.2 Well-control System

The primary function of a MODU’s well-control system is to stop formation fluids (water, gas and/or oil) from flowing from the well in an uncontrolled manner during drilling operations. To support that function, it must also be capable of preventing formation fluids from entering the well, detecting such an influx, should it occur; and, safely circulating out the influx and re-establishing overbalance with formation pressure in the well.

This section outlines:

- i) Main elements of the well-control system;
- ii) Major malfunctions;
- iii) Industry standards; and
- iv) Safeguards that are normally in place.

3.6.2.1 Major Well-control System Components

The major elements of a well-control system are the blowout preventer (BOP) stack and its control system, the kick detection system, and the system for circulating out kicks. This review will look most closely at the blowout preventer stack and its control system.

BOP Stack

On floating MODUs, the BOP stack is usually located at the seafloor attached to the wellhead, whereas, on jack-up MODUs and platforms, it is located on top of a high-pressure riser directly below the rig floor.

BOPs operate by closing a set of steel gate-type valves (ram preventers) or deformable rubber elements (annular preventers) to shut-off flow from the well. Pipe rams close around the drill pipe used in the drill string; whereas, annular preventers can seal around virtually any shape or size that extends across the stack. On most offshore drilling units four or five ram preventers are installed, and up to two annular preventers. At least one of the rams sets is designed to cut the drill pipe and subsequently seal the well (shear ram). All of these devices operate by hydraulic power provided by the MODU. The ram-type preventers are usually rated for a wellbore pressure of 103 MPa (15 000 psi), although this may be lower for older or specialized drilling units. In deep water, an additional set of shear rams capable of cutting casing is usually provided, although these rams are not able to seal the well following a cut. Figure 12 shows a general arrangement of a subsea BOP stack.

It should be noted that shear rams are not normally capable of cutting the heavy-walled drill collars that make up the bottom 10% (approximately) of the drill string. Also, they are not capable of cutting the tool joints that connect the joints of drill pipe together.

BOP Control System

The hydraulic system that provides power to operate BOP stack functions consists of two major parts: a hydraulic power supply composed of a hydraulic power unit (HPU) installed on the MODU, together with the hydraulic lines necessary to transmit the power to the stack; and, a control system that directs the hydraulic power to the correct function and regulates the operating pressure.

In most cases, the hydraulic power system operates at 21 MPa (3 000 psi) for surface and shallow-water stacks, and 34MPa (5 000 psi) for deep water subsea stacks. Hydraulic pressure is required both to close and open the rams, annular preventers and other devices. Should pressure be lost, preventers fail in the position when power is lost, or “fail as-is” (FAI). In the case of the choke and kill valves, these are spring loaded such that they will close if hydraulic pressure is lost; thereby stopping flow through the line. This

is known as fail-safe close (FSC). This is standard nomenclature for process safety, and more information regarding this style of device can be found in standard process safety texts.

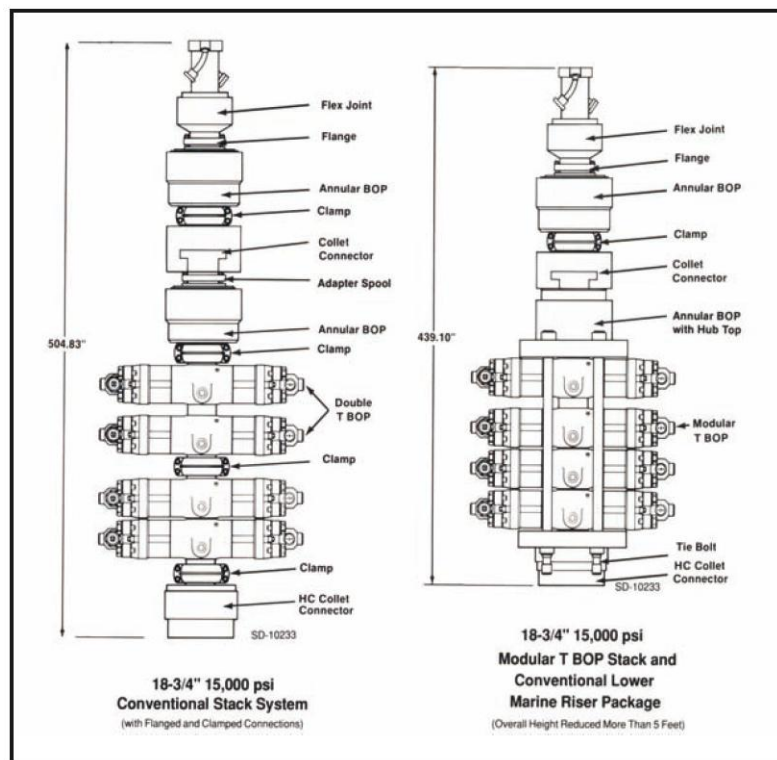


Figure 12 - Blowout Preventer Stack for Subsea Service

Source: (Well Control Manual WCS, 2002)

Shallow-Water Operations: Discrete Hydraulic Control System

On MODUs operating in shallow water, where the BOP stack is installed above the water surface, such as a jack-up or rig installed on a production platform, hydraulic power from the HPU can be used directly to operate stack functions. Where the BOP stack is installed at the seafloor, however, the length of time required to transmit the hydraulic power from the HPU to the stack results in a significant delay between actuation of the function at the rig and closing of the preventer. For these reasons, MODUs with subsea stacks in shallow water use a pilot signal method called the Discrete Hydraulic System (DHS).

Control Umbilicals

DHS uses hydraulic pilot signals transmitted from the MODU's HPU to the stack through small diameter hoses (one for each function) bundled together in an umbilical, which also contains a single power-fluid supply line. The umbilical is attached to the stack's hydraulic system by means of a disconnectable pod. The pod contains hydraulically operated directional control valves (DCVs) that direct hydraulic power from the accumulators to operate the desired stack function. A DCV is actuated by means of a pressure

pulse relayed through the pilot line to which it is connected, and, since the volume needed to provide these pulses is small compared to the BOP function itself, the response time is reduced substantially.

To ensure full redundancy in the control system, two identical systems, including umbilicals, are always used. To differentiate these systems, they are normally coded red and blue. The operator on the MODU selects the system to be used (red or blue, but cannot select both simultaneously) to operate stack functions. Each BOP function has a single pilot line operating a single DCV function within one of the two control pods. Actuation pressure from the two pods is separated by a shuttle valve that directs the pressurized hydraulic fluid to the desired function (open/close). Once the system to be used is selected, the shuttle valve lines up to the corresponding pod. The hydraulic line from (and including) the shuttle valve to the BOP function becomes the single point of failure for that specific BOP function, presuming there is not a failure of all systems passing through a common location, such as the moonpool. The Discrete Hydraulic System is shown in Figure 13.

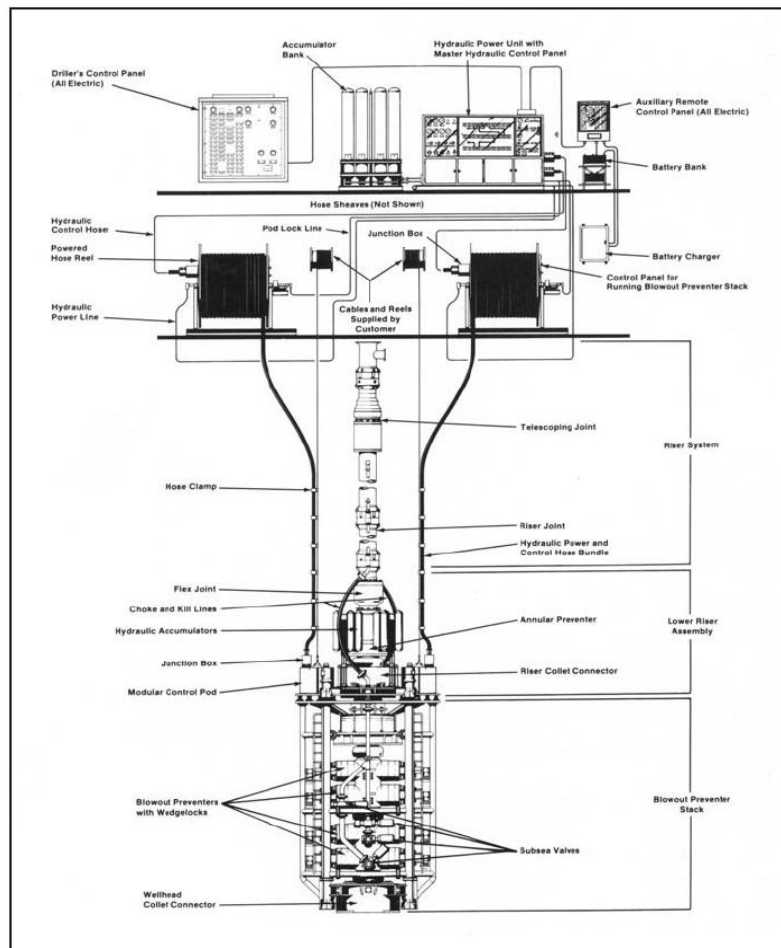


Figure 13 - Discrete Hydraulic System

Source: (Well Control Manual WCS, 2002)

BOP Accumulator Bank

The umbilical's hydraulic power supply line connects through the pod to a bank of accumulators mounted on the stack. These accumulators serve as a reservoir for pressurized fluid for stack operations such that it is not necessary to wait for delivery of power fluid from the surface.

Deep water Operations: Electro-Hydraulic/MUX

In deep water DHS result in delayed stack operation due to the slow transmission of the pilot pressure pulses through the long control hoses. For this reason, systems designed for deep water applications use electrical impulses for pilot signals. This is referred to as an Electro-Hydraulic system (E-H). The hydraulic power supply system for this system is similar to DHS, although the power supply main is normally fastened directly to the body of the riser in a similar manner to the choke and kill lines.

Early designs of E-H system used a separate electrical line for each stack function. Modern designs, however, use a multiplex (MUX) system whereby all the coded communication signals for a pod's DCVs are sent through two electric cables: one for the yellow pod, one for the blue pod. A Subsea Electronic Module (SEM) then reads the coded signals and sends electric power to the required DCV. Figure 14 shows the major components of an Electro-Hydraulic MUX BOP control system.

One of the additional advantages of the E-H/MUX system is its much smaller umbilical. This is because the electrical conductors are a fraction of the diameter of the DHS hydraulic lines, and because the hydraulic power supply line is connected directly to the riser, instead of being integral to the umbilical. Other advantages include the ability to build additional redundancy into both the umbilical and the control pod by having more than one communication line and SEM, and the ability to relay additional data back to the surface, such as pressure and temperature monitoring of the wellbore. Disadvantages of the MUX system include its greater complexity, the need to provide a reliable source of power for its electronics, and the need to absolutely isolate it from seawater intrusion.

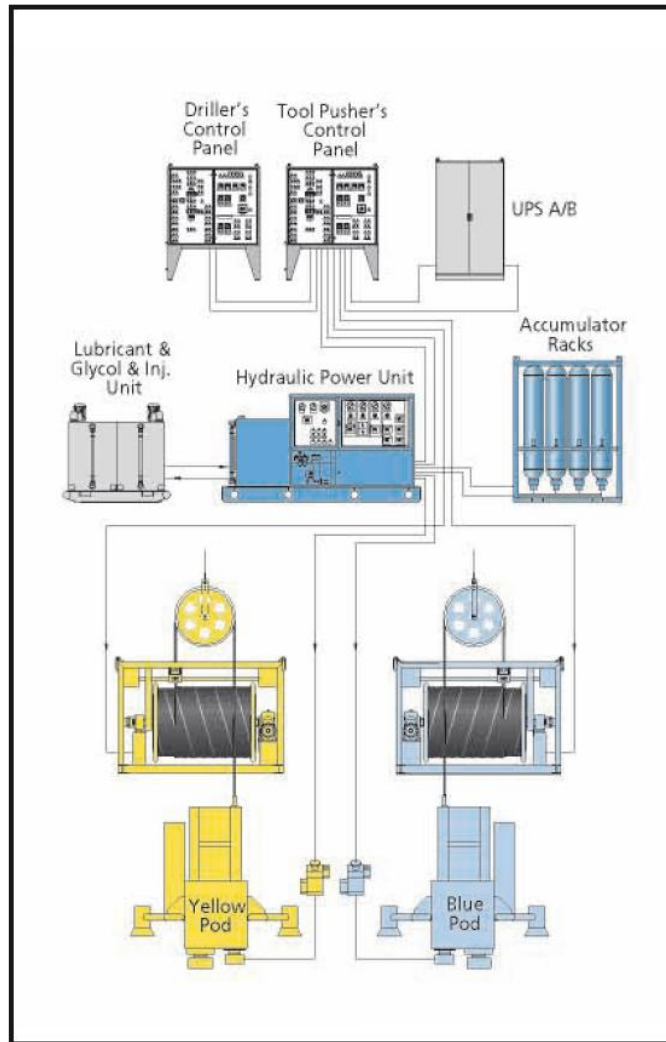


Figure 14 - Electro-Hydraulic MUX system

Source: (Well Control Manual WCS, 2002)

3.6.2.2 Deep Water BOP System Hazards

Although rare, a number of events can occur that can lead to problems with the well control system when drilling with use of a subsea BOP stack. These are outlined below.

A) Inability to Operate the BOP Stack

As described previously, BOP pipe and shear rams by design are FAI. Should an explosion, fire or structural failure result in casualties and/or serious equipment damage on the MODU, it is possible that communication with the stack can be lost, particularly where the damage occurs in the vicinity of the moonpool, as all the control and power systems have to run through this area.

B) Shear Ram Malfunction

In some cases, an unshearable component of the drillstring, such as drill collar or drill pipe tool joint may be positioned across the shear rams when an attempt is made to close the rams. Normally, the driller will check space-out of the drillstring to prevent such an occurrence. It is also possible that heavy-walled casing may be across the stack when the attempt is made to close the shear rams.

C) Excessive BOP Stack Side Forces

Where a dynamically positioned (DP) MODU suffers a drive off or drift off incident, the maximum disconnect angle of the lower marine riser package (LMRP) connector can be reached quickly. Should this occur, the connector can no longer be released. Further excursion can result in the stack and wellhead being pulled over or failure of the riser resulting in it breaking and falling to the seafloor. This is a particular problem while running casing in DP mode, as the shear rams cannot cut heavy walled casing. Such an event can also occur in the case of an anchored MODU where multiple anchor lines fail catastrophically.

D) Iceberg/Pack-ice Incursion

In deepwater wells off Labrador and in the Orphan Basin, incursion of icebergs or pack ice into the vicinity of the well results in the need to rapidly disconnect from the well in order to prevent collision. Normally this is accomplished by setting a plug such as a retrievable packer in the well with the drill string suspended from it, following which the shear rams are closed and the LMRP disconnected.

E) Inadvertent LMRP disconnect

Should the LMRP inadvertently disconnect from the stack during drilling operations, or should the riser rupture near its base, the well will lose its riser margin. Riser margin is the difference between the pressure of the column of mud in the well at the seafloor and the hydrostatic pressure of the seawater. When this occurs in deepwater, and the BOP stack is left open, the well will become underbalanced. Should a reservoir be open, the formation fluids will flow into the well.

F) Common Mode Failure

All systems for the subsea stack on MODUs are routed through the moonpool, including control, power and riser tensioning. This area is vulnerable to fire, explosion and structural collapse, such as would result from a release of gas during a well-control incident. Such an event can disable most, if not all of these systems in an event referred to as common mode failure, causing access to the stack and its control jeopardized at a time when it is needed most.

3.6.2.3 API Standard for BOP Control Systems

The oil industry standard for BOP control systems is API 16D “*Specification for Control Systems for Drilling Well-control Equipment and Control Systems for Diverter Equipment*” (API, 2004). Paralleling this specification is the recommended practice RP16E, Design of Control Systems for Drilling Well-control Equipment (API, 1990; *note: appears to have been withdrawn by API*), and recommended practice RP53, Blowout Prevention Equipment Systems for Drilling Operations (API, 2004). Among these standards, Spec 16D is the primary source of information for design of BOP control systems.

Although 16D distinguishes between Discrete Hydraulic and Electro-hydraulic/MUX systems for subsea operations, the requirements are the same for important functions, such as HPU pump systems, topside accumulator capacity, and shutdown panels. Response time is also the same: 45 seconds to close and seal rams, and 60 seconds to close an annular preventer.

API 16D Emergency System Requirements

To deal with emergency situations, API 16D includes a number of optional emergency systems to enable the well to be closed in and other critical operations undertaken. These are as follows:

- ***ROV Intervention (all water depths)***

ROV Intervention provides an interface panel to permit a ROV to perform some or all of the following functions:

- Blind/Shear Rams Close
- Pipe Rams Close
- Choke/Kill Valves Open
- Choke/Kill Valves Close
- Ram Lock
- Wellhead/LMRP connector unlock

It should be noted that no supply of hydraulic power fluid is provided on the stack for ROV operations. This must be provided through the ROV interface.

- ***Acoustic Remote Control (all water depths)***

Acoustic control is a backup system that provides a means for controlling critical BOP functions following loss of communication with the stack. It consists of a portable surface electronics package, a subsea electronic package and a subsea electro-hydraulic package mounted on the stack. The

surface electronics package is portable and can be operated from a vessel adjacent to the MODU, if necessary. It sends a coded signal to the subsea electronics package that relays commands to the system's electro-hydraulics package.

Both the subsea electronics package and the subsea electro-hydraulic package are installed permanently on the stack and interface with the main hydraulic control system. The acoustic system requires its own accumulator bank on the stack. This bank is supplied by the main power supply system; however, it is separated from it by means of an isolation valve.

- ***Emergency Disconnect Sequenced System (deepwater)***

Emergency Disconnect Sequenced System, also known as Automode Function (AMF), is optional for deepwater drilling units but a requirement for DP MODUs to account for a drive-off or drift-off situation. This enables all the functions necessary for closing of shear rams and disconnection of the LMRP to be performed by actuating a single function on the well-control panel.

- ***Autoshear (deepwater)***

Autoshear is a safety system designed to automatically shut in the wellbore in the event of disconnect of the LMRP. A similar system automatically disconnects the LMRP when maximum angle has been reached. When armed, disconnection of the LMRP results in the shear rams closing.

- ***Deadman (deepwater)***

A Deadman system is designed to automatically close the shear rams in the event of simultaneous absence of hydraulic fluid supply and signal transmission capacity in both subsea control pods.

Where some or all of the emergency systems stated above have been included in the stack, it can be considered FSC, rather than FAI.

- ***Shear Ram Boost***

API 16D refers to a rapid discharge system with increased operating pressure, but does not specifically require it.

- ***Casing Shear Rams***

API 16D refers (C.1.3 Examples 6, 7, and 8: BOP Equipment Configuration for Rapid Discharge System) to a set of casing shear rams to be installed in a subsea BOP stack, but does not require these.

3.6.2.4 Well Monitoring

The system used almost ubiquitously in drilling operations to monitor for formation fluid influx is the pit level indicator system. This system is based on the assumption that any difference between what is pumped into the well and what flows out of the well, both losses and gains, will show up as a difference in the total volume of drilling fluid in the pits and hence a difference in pit levels. This is supplemented by a paddle-style indicator mounted in the flowline that indicates simply whether the well is flowing or not, but which cannot indicate flowrate.

3.6.3 Canada-Newfoundland and Labrador Offshore Petroleum Board

A detailed description of the Canada-Newfoundland and Labrador Offshore Petroleum Board can be found in Section 3.1.

3.6.3.1 Drilling and Production Regulations

In December 2009 the Newfoundland and Labrador Offshore Drilling and Production Regulations (ODPR) were repealed and replacement regulations promulgated (C-NLOPB, 2009).

3.6.3.2 ODPR Philosophy

One of the most significant changes in the ODPR was the introduction of a management system section (Section 5) that requires an Operator to integrate management of operations and technical systems with those for financial and human resources. Specific requirements include:

- i) Policies on which the Operator's management system is based;
- ii) Means of goal setting for improvement of safety, environmental protection;
- iii) Hazard identification and risk management;
- iv) Training and competency of personnel;
- v) Integrity assurance and facility management;
- vi) Internal reporting and analysis of hazards and incidents along with a process for corrective action;
- vii) Management system processes and means for making personnel aware of roles and responsibilities;
- viii) Document management;
- ix) Audit process;

- x) Co-ordination between Operator and contractors; and
- xi) Single point of accountability for the Management System.

The strength of this system, with respect to well control, is that, for wells being drilled in deep water or in HPHT conditions, the onus is placed to keep pace with these increasingly complex technologies, to define risks and their acceptance levels, and to ensure that the well design, drilling procedures and the drilling equipment provide the necessary level of protection to allow the well to be drilled safely. Other advantages include:

- The Operator must self-audit with respect to both its own and its contractors' performance to ensure compliance with company policies and regulatory expectations, with audits also performed by the regulatory agency;
- Planning and execution of drilling operations is not undertaken solely by the Operator, but instead is performed by a team consisting of Operator, drilling contractor and service company personnel, with the management system providing the means by which the activities of all of these groups are controlled and coordinated;
- Best practices and new technology associated with complex wells, such as those in deep water and/or HPHT, can be introduced in a timely manner without need to introduce regulatory change; and
- Where a number of jurisdictions have similar regulations, learnings regarding improvements to the system can be shared. In addition, in cases where operator and drilling contractor personnel have been transferred to the Newfoundland and Labrador Offshore Area from another jurisdiction using this regulatory process, the time required to learn C-NLOPB's regulatory requirements can be reduced significantly.

3.6.3.3 Drilling Operations

Section 6 of the *Drilling and Production Regulations* requires that an Operations Authorization (OA) be obtained for the program prior to the commencement of work. The following must be included with the application:

- Execution plan;
- Description of MODU, including its drilling and well-control equipment;
- Management system (Section 5);
- Safety plan (Section 8);

- Environmental protection plan (Section 9); and,
- Certificate of Fitness for the MODU (*Certificate of Fitness Regulations*).

The *Drilling and Production Guidelines* provide additional details regarding expectations of information to be included with an Application for Authorization.

Approval to Drill a Well

Once an OA has been granted under Section 6 of the ODPR, an application can be made under Section 10 for an Approval to Drill a Well. In support of this application, the Operator must provide (Section 11) a comprehensive description of the drilling program, as outlined in Table 3.

Table 3 - Submission Requirements for Approval to Drill a Well Application (NL)

Section	Requirements
11.1.1	Well name/classification Operator's and participants' working interest Purpose of well Rotary table elevation Elevation of the wellhead Water depth Tentative survey plan Proposed depth of the well Proposed spud date Estimated time required to drill
11.1.2	Seafloor and shallow hazards Geological prognosis and summary of lithology Depth and nature of lost circulation, overpressure, swelling shale problems Pore pressure and fracture gradient profiles Rig move and positioning procedures Sequence of operations Well evaluation plan Casing and cementing program as well as details of the casing design Casing pressure testing program Formation leak-off tests Drilling fluid and solids control plans Directional drilling and survey plans Description of the well-control equipment Plans for pressure testing and function testing well-control equipment

Well Design

Sections 39 - 41 of the *ODPR* deal with casing design and cementing. These requirements are performance based, although the *Drilling and Production Guidelines* stipulate safety factors for casing design: 1.0 for burst and collapse, and 1.6 for tension. It is noted that the burst safety factor for surface

and intermediate casing has been reduced from the 1.33 stipulated in earlier versions of the *Drilling Regulations*. The guidelines permit the use of Load and Resistance Factor Design as an alternative. No reference is made to external standards. There is no stated requirement for verification of well basis of design.

Well Barriers

The Drilling and Production Regulations deal with barriers to flow in two ways: as *well barriers* and as *Safety Critical Elements*.

The Drilling and Production Regulations define a barrier as “...*any fluid, plug or seal that prevents petroleum or any other fluid from flowing unintentionally from a well or from a formation into another formation.*”

Section 36 (well-control) deals with barriers as follows:

“(2) After setting the surface casing, the operator shall ensure that at least two independent and tested well barriers are in place during all well operations.

(3) If a barrier fails, the operator shall ensure that no other activities, other than those intended to restore or replace the barrier, take place in the well.

(4) The operator shall ensure that, during drilling, except when drilling under-balanced, one of the two barriers to be maintained is the drilling fluid column.”

This is supplemented by Section 36.3 of the Guidelines that refer to NORSOK standard N-010 as a guide to defining barrier diagrams, and 36.5 that deals with barrier policies, procedures and work instructions.

In addition, Section 25(a) requires that:

“all wells, installations, equipment and facilities are designed, constructed, tested, maintained and operated to prevent incidents and waste under the maximum load conditions that may be reasonably anticipated during any operation;

This is supplemented by Section 25.9 of the Guidelines which defines casing, tubing and wellheads as *Safety Critical Elements*, for which performance standards must be developed, and which must be evaluated in terms of effectiveness on a regular basis. While no conflict is seen for platform wells, it may be difficult to satisfy the requirements for SCEs in the case of subsea wells, given restricted access to some of these components.

Requirements for Drilling Equipment

The C-NLOPB *Guidelines for Drilling Equipment* and *Drilling and Production Guidelines* form the basis for determining whether a MODU is “Fit for Purpose” for operation in the Newfoundland and Labrador Offshore Area under the *Installation Regulations*. This evaluation is undertaken by an independent Certifying Authority (CA) approved under the *Certificate of Fitness Regulations*. Once the CA has been satisfied that a MODU conforms to these requirements, the Operator may then make a Declaration of Fitness under Section 135.1 of the *Canada-Newfoundland and Labrador Atlantic Accord Implementation Newfoundland and Labrador Act* permitting the MODU to be used in drilling programs within C-NLOPB jurisdiction.

Well Control Competency and Training

The third essential element in assuring that well control will be maintained during drilling operations is Personnel Competency and Training. This category consists of an array of skills that personnel both onshore and on the MODU must possess and demonstrate, including:

- Design of a well to minimize risk of influx, and the ability to safely shut-in a well;
- MODU operations and maintenance procedures to ensure well monitoring and control equipment is functioning correctly;
- Well-construction techniques and operating procedures to minimize risk of influx;
- Well monitoring to detect influx;
- Well shut-in procedures to halt an influx;
- Well-kill techniques to circulate out a kick and re-establish control of the well; and
- Emergency response to prevent a serious well-control problem from continuing to deteriorate to blowout.

Part 10 of the Drilling and Production Regulations require that “*all personnel have, before assuming their duties, the necessary experience, training and qualifications and are able to conduct their duties safely, competently and in compliance with these Regulations*”.

This is supported on the MODU by the Canadian Association of Petroleum Producers *Standard Practice for the Training and Qualifications of Personnel*, April 2008, which defines the well-control training and certification requirements for supervisory personnel. The standard specified is the IADC-WELLCAP or IWCF Well-control Certificate course, which is a five-day course that covers all aspects of kick prevention, detection and well kill.

3.6.4 Norway

The Petroleum Safety Authority (PSA) is the regulatory authority for technical and operational safety for the Norwegian Offshore Area. The PSA's regulatory role covers all phases of operations, from planning and design through construction and operation to removal of facilities. The PSA has been designated the authority to promulgate regulations, supervise compliance and follow-up to ensure that operators and their contractors maintain acceptable standards of health, environmental protection, and safety and emergency preparedness. (Petroleum Safety Authority Website: www.psa.no).

3.6.4.1 Supervisory Activities

The following activities enable the PSA to confirm that companies are fulfilling their duties:

- Management system audits
- Verification
- Investigation
- Consents
- Meetings with industry
- Surveys
- Studies
- Hosting professional seminars
- Development of regulations

3.6.4.2 Focus on Management System Performance

PSA examines the management system activities of Operators and their contractors, including their audit mechanisms. The companies' HSE management performance and practices indicate the level of their control of relevant risks, their ability to reach goals and the degree of compliance with regulatory requirements.

3.6.4.3 Risk-based Approach to Audits

Audits are expected to be system-oriented and risk-based.

3.6.4.4 Focus on Actual Circumstances

The PSA verifies that operations conform to regulatory and management system requirements through measurement, testing and inspection.

3.6.4.5 Active Provision of News and Information

The PSA communicates with the industry through its website concerning various HSE activities, including results from audits and investigations, reports, trends and statistics, focus on accidents and PSA

priority areas. Information made available includes audit reports, investigation reports, notifications of orders, brief consent reports, reports of Acknowledgments of Compliance, and letters to the industry.

3.6.4.6 Collaboration with Foreign Safety Regulators

The PSA participates actively in the International Regulators Forum, together with the United States, Canada (including C-NLOPB), Australia, the United Kingdom, Brazil and others.

3.6.4.7 Dialogue between the PSA and Operators/Contractors

The PSA uses dialogue as the main instrument to influence decisions/actions. If this does not lead to improvement, “Notice of Orders” can be given, followed by “Orders”. In serious cases where safety is endangered, an activity can be temporarily stopped.

3.6.4.8 Dialogue with Other Parties Involved in the Petroleum Industry

Dialogue is also established with employers, unions and government and workers with the purpose of improving the companies’ HSE management systems and practices. The PSA chairs two arenas involving employers, unions and Government.

3.6.4.9 Regulatory Forum

The Regulatory Forum does not have a governing role, but is an important forum for discussions and advice within the field of HSE. It facilitates:

- Information, discussion and consultation on development and maintenance of framework documents for the petroleum activities such as regulatory strategy and regulatory work, adaptation to EU regulations and other international frameworks related to health, safety and the environment in the petroleum industry;
- Information and discussion regarding practical implementation and use of the HSE regulations; and
- Exchange of viewpoints relating to contents and experiences in connection with implementation of the individual regulatory work.

3.6.4.10 Safety Forum

The Safety Forum is the central forum for cooperation among parties in the industry and authorities regarding HSE in the petroleum-related activities on the Norwegian shelf. The main objectives are:

- Participation by managers, HSE personnel and key decision-makers among the parties in the industry and the Petroleum Safety Authority Norway, and with the Ministry of Labour and Social Inclusion being an active observer;
- Stimulating cooperation and debate on key HSE challenges in petroleum-related activities;
- Providing a consultation roundtable for strategic HSE projects and processes within PSA's area of responsibility; and,
- Providing a driving force behind dissemination of information and knowledge regarding HSE and the development and establishment of positive HSE cultures.

3.6.4.11 Other Forums

The PSA also participates in a number of other forums, including the RVK project and Working together for Safety, as described below:

- *The RVK project*

RVK is a training program for the petroleum industry providing courses in regulations. It is a joint project between authorities, employers and employees aiming at increasing the knowledge and awareness around HSE regulations.

- *Working Together for Safety*

The *Working Together for Safety* project is one of the most extensive collaboration projects initiated within health, safety and the environment (HSE) in the oil and gas industry. The project concentrates on safety on offshore installations, onshore installations and on-board vessels on the Norwegian Shelf, and focuses on all conditions that affect the nature of the work. This entails, among other things, focusing on corporate culture, structure, organization and management.

This project contributes to:

- Improving safety in the oil and gas industry offshore;
- Reducing risk of personal injury and major accidents;
- Improving employees and their families' trust in the industry;
- Strengthening trust and cooperation between the players in the industry; and
- Improving the reputation of the industry.

3.6.4.12 Regulatory Philosophy

Following the loss of the *Alexander L. Kielland* semi-submersible MODU in 1980, Norway implemented widespread changes to its regulatory structure for offshore oil and gas operations. A single point of contact was established for regulation of the industry, and a set of regulations were introduced that required operators to implement a comprehensive process of Internal Control (IC) to identify and manage their risks and prevent accidents such as well blowout.

3.6.4.13 Regulations for Drilling Operations

The PSA regulates drilling operations for blowout prevention through the *Facilities Regulations* (FaR) for MODUs and the *Activities Regulations* (AR) for well construction (PSA, 2010). Each refers, through guidelines, to NORSOK standards to supplement the regulations. In the case of the AR, NORSOK D-010 “*Well Integrity in Drilling and Well Operations*” (NPD, 2004) is used extensively. This standard defines requirements for well design, drilling activities, well control, well construction and barrier requirements across a wide variety of well configurations.

Section 72 of the AR deals with information required when making application for a well program. This section refers to NORSOK D-010 as outlined in Table 4. It is a guiding principal of the PSA that it is the responsibility of the Operator to prove that it is in control of the operations it intends to perform.

3.6.4.14 Well Design

Section 72 of the AR lays out requirements for the design of wells, with explanatory guidelines referring to NORSOK D-010 Section 4.3 for additional details regarding the types of analysis that are to be performed, together with stipulating maximum probability of failure. Selection of load scenarios and analysis methodology are, however, left up to the Operator, although PSA conducts a review of the application upon submission.

3.6.4.15 Well Barriers

Section 76 of the AR and Section 56 of the FaR deal with barriers to flow in a complementary fashion. The guidelines supporting the AR and FaR both refer to Sections 4.2 (barrier requirements) and 15 (acceptance criteria) of the NORSOK Standard D-010, with FaR also referring to Section 9, sidetrack and abandonment. The treatment of barriers and barrier envelopes and acceptance criteria in these regulations, guidelines and standards is comprehensive and thorough. One of the weaknesses is that although drilling fluid is accepted as a barrier, no criteria are provided regarding the means of keeping weighting material in suspension in order to maintain the integrity of that barrier. For example, drilling fluid that is weighted using suspended material such as barite can only be accepted if a means of circulating the drilling fluid is

provided, and, indeed, the drilling fluid is circulated within a prescribed time period in order to prevent the solids from settling out, thus negating the effectiveness of the barrier.

Table 4 - Norwegian Requirements for Submission of Information for Well Approval

NORSOK Section	Requirements
4.3 Well Design	<p>Risk of failure of the well, as determined by means of risk assessment, conform to the Operator's acceptance criteria during the defined life cycle of the well;</p> <p>Minimum expectations for inclusion in well basis of design:</p> <p>Current well status</p> <p>Purpose of well</p> <p>Temperature, pore pressure and formation strength prognosis, including uncertainties</p> <p>Design life requirements, including abandonment scenarios</p> <p>Geological depth prognosis with expected stratigraphy and lithology, including uncertainties</p> <p>Potential hazards that may cause loss of well integrity</p> <p>Description of formation fluids</p> <p>Well path listing, target requirements and proximity calculations to offset wells</p> <p>Summary of reference well data and experience feedback;</p> <p>HSE considerations in relation to selection of fluid type/cuttings handling and disposal</p> <p>Minimum expectations in respect of load case scenarios to be used in the design, together with a requirement for the Operator to develop minimum acceptance criteria;</p> <p>Expectations regarding the Operator's minimum design factors for loading conditions for the well, including burst, collapse, axial loads, and tri-axial (combined) load conditions; and</p> <p>A requirement for probabilistic calculation of loads and ratings, that probability of failure is to be no greater than $10^{-3.5}$</p>
4.7 Well Program	<p>Minimum requirements for information to be contained in a well program</p> <p>Expectation that major contractors are to be involved in development of the program</p> <p>Documentation, approval and distribution of changes to the program</p> <p>Update requirements for programs lasting more than 1 year</p> <p>Requirements for program development where a well is to be used for a purpose other than for what it had been intended</p>
4.10.3 Well Integrity Information	Documentation requirements
9.3 Plugging of Wells	Acceptance criteria for well barriers to be used for suspension and abandonment

BOP Activation System

In Norway, MODUs are required to have an alternative activation system for activating critical functions on the BOP for use in the event of an evacuation. Examples of acceptable systems include: acoustically operated, ROV operated or remotely controlled in some other way. There are also requirements on the

Norwegian Continental Shelf stating that MODUs shall be equipped with a disconnection system that secures the well and releases the riser before a critical angle occurs.

3.6.4.16 Training and Competency

Norwegian requirements are divided amongst the Activities Regulations, the Facilities Regulations and the Management Regulations, as follows:

Table 5 - Norwegian Well-control Regulations

FaR Section 10	<ul style="list-style-type: none"> Competence for all phases of the petroleum activities shall be assured Personnel at all times shall have the competence necessary to carry out activities safely
FaR Section 14	<ul style="list-style-type: none"> Operator shall ensure that contractors and suppliers are qualified and competent
AR Section 20	<ul style="list-style-type: none"> Employees shall be given necessary safety training
AR Section 19	<ul style="list-style-type: none"> Operator is capable of handling situations of hazards and accidents
Management Regulations, Section 11	<ul style="list-style-type: none"> All relevant personnel shall have necessary system knowledge and HSE competence, including knowledge of hazard and risk reduction, barriers, and safety culture. This includes competence for all positions and roles, including auditors, management system administrator, maintenance personnel.
Management Regulations, Section 11	<ul style="list-style-type: none"> Operator and contractors must identify potential failures or mistakes by those performing tasks that can lead to major accident/serious HSE consequences
AR Sec. 20	<ul style="list-style-type: none"> Requirements regarding training needs are adjusted when new work tasks, new equipment/technology etc. are introduced Criteria shall be established as to what is to be deemed necessary training
AR Sec. 19	<ul style="list-style-type: none"> NORSOK D-010 forms the basis for fulfillment of PSA requirements, together with ISO 15544 <i>“Petroleum and natural gas industries --Offshore production installations -- Requirements and guidelines for emergency response”</i> and OLF’s Guidelines for safety and emergency preparedness training No. 002 revision 16 for emergency preparedness and safety.

3.6.5 United States

3.6.5.1 Introduction

The regulatory regime employed by the United States is currently in a state of transition due to the recent and ongoing changes to the Department of Interior agencies. Regulatory functions undertaken previously by the Minerals Management Service have now been transferred to a new agency: Bureau of Ocean Energy Management - Regulatory Enforcement (BOEMRE).

3.6.5.2 Regulatory Philosophy

The philosophy of the US Government in regulating well operations in the Outer Continental Shelf area in places such as the deep water Gulf of Mexico is to apply regulations that provide detailed prescriptive

requirements for the way wells are designed and built. These requirements are contained in Regulation 30 Code of Federal Regulations 250, with additional requirements issued from time to time by means of Notices to Lessees (NTLs).

3.6.5.3 United States: Applications for Well Permit

Regulation 30 CFR 250.201 states that an Exploration Plan (EP), Development and Production Plan (DPP), or Development Operations Coordination Document must be in place in order to commence any activities on a specific lease, following which an Application for Permit to Drill (APD) may be made under CFR 250.410. CFR 250.411 describes the information that must be provided in support of an application for APD, as outlined in Table 6.

Table 6 - Information Required in Support of APD, per 30 CFR 250.411

CFR	Information to be included with APD
250.412	Plan showing location of proposed well
250.413	Design criteria used for proposed well, including: <ul style="list-style-type: none"> • Pore pressure • Formation fracture gradient, adjusted for water depth • Potential lost circulation zones • Drilling fluid weights • Casing setting depths • Maximum anticipated surface pressure
250.414	Drilling prognosis, including: <ul style="list-style-type: none"> • Coring plans • Logging plans • Planned safe drilling margin between proposed drilling fluid weight and estimated pore pressure • Depths to the top of significant marker formations • Depths to significant porous and permeable zones containing fresh water, oil, gas, or abnormally pressured formation fluids • Depths to major faults • A list and description of alternative procedures or departures from requirements • Plans for well testing
250.415	Casing and cementing programs, including: Hole and casing sizes Casing setting depths Casing types and grades Casing design safety factors Type and amount of cement Statement regarding the means of evaluating shallow hazards in water depths >500ft
250.416	Diverter and BOP systems description
250.417	MODU
250.418	Additional Information

In addition to the above, BOEMRE has issued NTLs on Standard Conditions of Approval for:

- NTL No. 2009-G21 Well Activities
- NTL No. 2009-G20 Standard Reporting Period for the Well Activity Report
- NTL No. 2009-G22 How to evaluate and manage wells that have a casing pressure during production

On September 30, 2010 BOEMRE also issued three additional NTLs with the following requirements:

Safety NTL:

- Submit a general certification from the CEO stating that the operator is knowledgeable of all operating regulations at 30 CFR 250 - Oil and Gas and Sulphur Operations in the Outer Continental Shelf. The certification should also state that the operator is conducting its operations in compliance with those regulations.
- Review its operations to ensure that they are performed in a safe and appropriate manner as required by 30 CFR 250.107(a)(1).
- Submit blowout preventer and well-control system configuration information for the drilling rig that will be used.
- Have a detailed physical inspection and design review of the blowout preventer performed by an independent third party.
- Obtain an independent third-party verification concerning the BOP's compatibility with the drilling rig to be used and the specific well design.
- Have in place a secondary control system with remote operated vehicle (ROV) intervention capabilities for the blowout preventer as well as an emergency shut-in system.
- Test the mechanism for the ROV capabilities while the blowout preventer is onboard the rig prior to placement subsea.
- Obtain an independent verification that the blowout preventer's blind-shear rams are capable of shearing the drill pipe under the maximum anticipated conditions. If the blowout preventer's blind shear rams are activated in a well-control situation, the blowout preventer must be physically inspected to ensure continued ability to operate.
- Certify through a Professional Engineer that all well casing designs and cementing procedures are appropriate for the purpose of the well under expected conditions.

Environmental NTL:

- Include in any new Exploration Plan or Development Operations Coordination Document (DOCD) or as a supplement to a previously submitted plan, a blowout scenario as required by 30 CFR 250.213(g) and 250.243(h).
- Submit a description of the assumptions and calculations that were used to determine the daily discharge rate of the worse-case discharge scenario as required by the relevant CFR for the respective plan, exploration or development. (If the operator's worse-case discharge volume exceeds the amount stated in the approved Oil-spill response Plan, the Oil-spill response Plan will have to be modified).
- Submit a description of the enhancements undertaken to prevent a blowout, to reduce the likelihood of a blowout, and conduct effective and early intervention in the event of a blowout.

Drilling Safety Rule

- Comply with the recommended practices cited in the industry document, "API Recommended Practices 65 - Part 2 Isolating Potential Flow Zones During Well Construction".
- Provide written description of how the best practices were evaluated; also must identify mechanical barriers and cementing practices to be used for each casing string.
- Submit as part of APD schematic drawings of all control systems and control pods.
- Perform a negative pressure test to ensure proper casing installation. This is done during drilling for the intermediate and production casing strings.
- Establish minimum requirements for personnel authorized to operate critical blowout preventer equipment.
- Test at least one set of rams on the blowout preventer using the ROV intervention methods during the initial test on the seafloor.
- Test the deadman system (one of the emergency shut-in system components) during the initial test of the blowout preventer on the seafloor.
- Receive approval from the appropriate District Manager prior to displacing kill-weight drilling fluid from the wellbore, and must submit the reasons for the displacement and provide detailed step-by-step procedures for the safe displacement.

- Ensure that rig personnel are trained in deep water well control and the specific duties, equipment, and techniques associated with deep water drilling.

3.6.5.4 Well Design

Regulations covering drilling operations are found mainly in 30 CFR 250 subparts D. These regulations are supplemented by reference to industry standards, e.g., API RP 53, with guidelines or supplemental requirements specific issues provided by means NTLs.

U.S. regulations do not provide explicit requirements regarding casing-design safety factors. Instead, Section 250.415 states that these are to be submitted with the APD for “tension, collapse, and burst with the assumptions made to arrive at these values”. This was strengthened, on September 30, 2010 when BOEMRE stipulated, in the *Drilling Safety Rule*, that a professional engineer must certify that the casing and cementing program for the well, for which application was being made, was appropriate for its intended purpose.

3.6.5.5 Well Control

30 CFR 250.401 deals with well-control with the following requirements:

- Take precautions to keep wells under control at all times;
- Use best available and safest drilling technology to monitor and evaluate well conditions and minimize the potential for the well to flow or kick;
- Have a person onsite during drilling operations who represents your interests and can fulfill your responsibilities;
- Ensure that the toolpusher, Operator’s representative, or a member of the drilling crew maintains continuous surveillance on the rig floor from the beginning of drilling operations until the well is completed or abandoned, unless you have secured the well with BOPs, bridge plugs, cement plugs, or packers;
- Use personnel trained according to the provisions of subpart O; and
- Use and maintain equipment and materials necessary to ensure the safety and protection of personnel, equipment, natural resources, and the environment.

The *Drilling Safety Rule* also made mandatory *API RP 65 - Part 2, Isolating Potential Flow Zones During Well Construction* (API, 2010). This document parallels NORSOK D-010, and contains detailed

requirements regarding the number and type of barriers that must be present, together with acceptance criteria for casing and cementing.

3.6.5.6 Training and Competency

Subpart O of the US regulations deal with Training and Competency of personnel. This emphasizes the need for competency in well-control through verified training programs, retention of knowledge and understanding, as well as periodic well-control training (30 CFR ch. II 250.1501 -1510). In addition, the Drilling Safety Rule, issued September 30, 2010, called for enhanced deep water well-control training in addition to the existing well-control training program.

3.6.6 United Kingdom

3.6.6.1 Introduction

The UK government released the *Safety Case Regulations* (SCR) in 1992 in response to recommendations of the Cullen Enquiry into the *Piper Alpha* disaster. These regulations require development of a Safety Case for all Installations within the UKCS. The Health and Safety Commission also recognised, however, the need for regulation of well operations over and above the requirements for a Safety Case. This led to the introduction in 1996 of the *Offshore Installations and Wells (Design and Construction, etc.) Regulations* (UK H&S Executive, 2008).

3.6.6.2 Regulatory Philosophy

The DCRs are goal oriented, and focus on reducing risks to as low a level as reasonably practicable. Operators must demonstrate a verification process implemented by independent assessment, and through that means prove that all well and operational conditions and compliances are met across the entire well life-cycle. This is an auditable process through planning and execution which should, if managed properly, prevent the initiation of a chain of events that could ultimately lead to a well control event.

3.6.6.3 Regulation of Drilling Operations

Regulation 3 of the DCRs deals with application for consent to drill.

3.6.6.4 Well Design

Regulation 13 General duty of the DCRs stipulate that a well be “designed, modified, commissioned, constructed, equipped, operated, maintained, suspended and abandoned” such that there can be no unplanned escape of fluids from the well, and that a well be safe during all stages of its life.

3.6.6.5 Well Barriers

Regulation 17 *Well control* of the DCRs refers to the need to have blowout preventers, downhole preventers, Christmas trees, internal blowout prevents, plugs, etc. to prevent flow from a well. No statement is made regarding the number of barriers necessary for each flow path, however, and no detailed requirements are stated regarding the number and type of barriers to be used.

Regulation 18 *Arrangements for examination* refers to the need for examination, by competent and independent persons, of the design and construction of a well to confirm that flow from the well will be prevented as far as this is reasonably practicable.

3.6.6.6 Training and Competency

Regulation 21 deals with the need to ensure personnel have the necessary “*information, instruction and training*” and are “*being so supervised*” such that the risk to health and safety from the planned operation is reduced to the lowest level that is reasonably practicable. No details are provided.

3.6.7 Australia

3.6.7.1 Introduction

Australia ensures well control during drilling of offshore petroleum wells by means of the *Petroleum (Submerged Lands) Act* 1967 and the *Petroleum (Submerged Lands) (Management of Well Operations) Regulations* 2004 (Well Operations Regulations). This legislation is administered by the National Offshore Petroleum Safety Administration (NOPSA). In the case of well operations, NOPSA has devolved responsibility to state agencies (e.g. WA, NT, etc.), referred to as the Designated Authority (DA). This is expected to change, however, following the investigation into the 21 August 2009 Montara blowout.

3.6.7.2 Regulatory Philosophy

The Well Operations Regulations were developed to ensure that the system implemented by the Operator for design and execution of offshore wells results in risks being reduced to as low a level as is reasonably practicable, in accordance with good oilfield practice. These regulations require that the Operator submit a Well Operations Management Plan (WOMP) to the DA for the planned well activities.

3.6.7.3 Well Design

No explicit guidance is provided for well design or design standards to be used .

3.6.7.4 Well Barriers

No explicit requirements are provided regarding the number or type of barriers to be used.

3.6.7.5 Training and Competency

While personnel are expected to possess the appropriate skills necessary to undertake planned operations, and appropriate training and competency programs are expected to be in place, no specific requirements have been stated regarding management of well control.

3.6.8 Evaluation of Canada-Newfoundland and Labrador Offshore Drilling Regulations

C-NLOPB regulations are similar in many ways to the Norwegian PSA. Despite its smaller size, it engages in similar activities to the PSA to confirm that companies are fulfilling their responsibilities. These include:

- Management system audits;
- Verifications;
- Investigations;
- Approvals/authorizations;
- Providing information to and meeting with industry;
- Participation in International Regulators forum; and
- Development of regulations and guidelines.

One area where C-NLOPB has not been active in recent years, however, has been in hosting specialized seminars to provide technology transfer into the local oil and gas community.

3.6.8.1 Policies and Procedures

Areas for discussion regarding changes to the Management System requirements contained in the ODPR are outlined below. These are included to form the basis for discussion in ways to further strengthen well-control management.

- Section 5.(2)(c): Risk Assessment

Sections 19 (f) and 25 - 43 of the Drilling and Production Regulations deal comprehensively with well-control during drilling operations but provide little guidance regarding risk assessment of well design and drilling operations. From discussions with C-NLOPB personnel, Operators perform “Drilling the Well on Paper” exercises aimed at identifying hazards prior to the start of drilling

operations; however, the guidelines do not refer to this or other techniques. Furthermore, whereas the regulations are referred to as “goal based”, there is no guidance regarding what constitutes an acceptable goal as it relates to well-control issues.

Considering the potential cost in human lives, environmental damage and resource loss, the only acceptable goal is “zero” blowouts. Blowouts are rare events, however, and do not lend themselves to risk analysis, particularly as wells vary widely in design and execution. A viable alternative is to extend risk assessment to the prevention, detection and proper handling of well kicks, as a kick represents the essential first step toward a well blowout. Software and analytic methods are available to facilitate this (Arild et al, 2009). In addition, it is possible to identify and assess the adequacy of safeguards, both hard (well barriers such as casing and cement, equipment and well components critical for well-control) and soft (policies & procedures, training and competency of personnel, audit of performance) that make up the entirety of the well-control management systems, including Operator, Drilling Contractor and specialized service providers. The Winter report into the Macondo blowout for the US Government recently noted:

“...the lack of a systems approach that would integrate the multiplicity of factors potentially affecting the safety of the well, monitor the overall margins of safety, and assess the various decisions from perspectives of well integrity and safety. The ‘safety case’ strategy required for drilling operations in the North Sea and elsewhere is one example of such a systems approach for integration of all of the factors that influence the safety of the well.” (Winter, et al., 2010)

- Reporting and Analysis of Incidents

Section 5.(2)(f) deals with a process for reporting and analysis of incidents and hazards, with Section 76 dealing with these issues in greater detail. In neither of these sections are well kicks or well-control issues classed as an Incident, unless it results in loss of containment. Should a kick be caused by poor operating practice, or occur with low kick tolerance, or should the size of the influx be large, the event should be reported and the necessary measures implemented to prevent a recurrence.

- Management of Change in Drilling Program

Section 5.(2)(j) deals with a process for ensuring documents are up to date and valid. Management of change is a key issue when dealing with execution of a well program, where changes are frequently necessary to react to unexpected conditions during drilling operations. It is worthwhile to stress MOC as the means by which documents are kept up to date in a drilling program.

- Interface between Operator and Drilling Contractor

Section 5.(2)(j) addresses co-ordination of management and operations between the operator, drilling contractor and others. This does not deal with the need to manage the multiple interfaces among these organizations, or to bridge between the Operator's and drilling contractor's onshore and offshore-management processes to prevent clashes and gaps in the management of well-control. This is particularly critical as both organizations, plus those of key service providers, must work together seamlessly to prevent well-control problems, and to react rapidly and correctly in emergency circumstances.

3.6.8.2 Blowout Preventer and Well Monitoring Equipment

Section 36.1 of the *Drilling and Production Guidelines* states that control systems for blowout preventer stacks for MODUs should conform to API Specification 16D and RP53. Section 29.6 of the *Drilling and Production Guidelines* states that:

“Operators should ensure that plans to assure well integrity are in place in the event of:

- *an emergency disconnect of the riser;*
- *structural failure of the marine riser system; or*
- *any other situation or event with the marine riser system that could give rise to the inability to actuate the BOP stack via the BOP hydraulic or multiplex control system.*

In the case of DP vessels and/or deep water operations, operators should consider the need to implement one or more of the following measures:

- *BOP stack ROV intervention capability;*
- *acoustic BOP control system; and*
- *two shear rams in the BOP stack.*

These measures would also play an important role where an emergency disconnect or loss of the riser would also result in the loss of the drilling fluid as the primary well barrier in cases where it is impractical to maintain a riser margin.”

These requirements go a long way toward dealing with emergency situations involving subsea stacks. These can be further strengthened, however, by requiring that one set of shear rams for deep water stacks be capable of shearing casing. In addition, consideration should be given to requiring ROV intervention for subsea stacks, or equivalent, for all water depths.

3.6.8.3 Training of Personnel

The CAPP Standard Practice is adequate for supervisory level personnel located on the MODU; however, it does not address well-control skills for non-supervisory members of the rig crew. This is usually dealt with by means of on-the-job training and drills undertaken during drilling operations. Given the complexity of modern drilling units, perhaps a statement of competency should be defined for non-supervisory personnel. In addition, it is noted that the U.S. National Academy of Engineering and National Research Council, in Section VI of its report on the causes of the Deep water Horizon blowout, called into question the adequacy of the well-control training, particularly in deep water drilling operations.

3.7 Regulation Philosophy - Comparison of Comparable Jurisdictions

Oil and gas-producing countries such as Canada, Norway, United Kingdom and Australia practice performance based or goal-oriented regulations. These countries set the general safety standards that must be met, but leave it to the operators to work out the details. The United States practices a more prescriptive approach. Another difference is that Britain, Norway and Australia have separate agencies overseeing the production and safety aspects of the oil industry to avoid conflict of interest. In Newfoundland and Labrador, the C-NLOPB manages and oversees both under one agency with distinctive independent roles.

Canada, Norway, Great Britain, and Australia moved away from prescriptive Government regulations to a goal-oriented or performance-based system because they realized that the industry developed so fast that stringent regulations were a setback to the development of safety standards and it would take considerable time to change regulations. A Canadian National Energy Board spokesman noted that “Governments determine the regulatory approach,” and that the Board supports the proposed regulations as “an effective regulatory regime for improving safety and environmental protection.” (Mayeda, A., 2010).

3.7.1 Norway

The Norwegian system for supervising the safety of its oil and gas industry is the product of four decades of continuous change, improvement and reform. The offshore petroleum industry began before the regulatory authority and safety regulations were created - Norway’s first oil well was drilled in 1966 but it wasn’t until 1973 when a commission created the Norwegian Petroleum Directorate (NPD) to propose new rules for the petroleum industry.

A new inspection philosophy was established to address any issues in the regulatory authority and formal guidelines were created in 1979. As a result, the industry had to comply with the regulations using a more active approach and was forced to adapt to a management culture that would ensure systematic control over their own operations.

The *Bravo* installation blowout in 1977 was the first oil blowout in the North Sea. It spilled 9 000 tonnes of crude oil before the well was brought under control. As a result, the NPD made it a requirement that the BOP must always be in place on each well and that a risk analysis be conducted on all risky operations.

In March 1980, the mobile accommodation rig *Alexander L Kielland* capsized in the Ekofisk field of the North Sea due to a weld failure on one of the braces holding the rigs flotation columns in place. The incident caused the death of 123 workers. After this disaster, a Commission of Inquiry was appointed. The Commission report was released in April 1981 and significantly changed the Norwegian regulatory

regime. In 1985, the new *Petroleum Activities Act*, which had new rules regarding safety within the oil and gas industry, was introduced. The most significant change, however, was that the NPD would be the sole agency responsible for developing regulations and supervising safety and the working environment in the offshore. The *Kielland* commission also recommended the need to improve coordination of regulatory agencies by reducing their number, as opposed to maintaining a number of different agencies conducting inspections on behalf of the Government. The NPD inherited the regulations of the other agencies expanding its regulatory portfolio. Norway now had a completely new regulatory regime to ensure its offshore oil and gas industry is managed in an acceptable manner.

Since the *Petroleum Activities Act* of 1985, the trend has been away from prescriptive toward a regulatory approach based more on performance and risk management. A series of reforms has resulted in regulations that are aligned with the changes in the regulatory approach. Norway's regulatory requirements are general, and primarily specify the conditions or functions that must be achieved to be compliant. Within this framework, companies have the freedom to choose practical solutions and the responsibility to ensure compliance. To avoid misunderstandings about regulatory compliance requirements, non-binding recommendations and guidelines that reference reputable Norwegian and/or international industrial standards for structures, equipment, or procedures have also been issued. These recommendations and guidelines rely primarily on DNV *Offshore Standards* that provide technical requirements, and acceptance criteria and *Recommended Practices* for proven technology and sound engineering practice (DNV, 2010).

This approach means that the regulator must keep abreast of and participate in developing and revising industry standards to ensure that they remain relevant and reflect best practice. Supervision by the regulator involves checking whether the administrative management systems at the individual companies ensure acceptable operation. This auditing must be conducted by personnel who have special technical and management expertise and experience.

The NPD acknowledges that the requirements for successfully enforcing performance-based regulations demands extensive participation from industry, employees, and the regulator, in terms of expertise, management and flexibility. To achieve a safe and environmentally responsible offshore work environment, strategic and operational plans must be drawn up, selected development measures implemented, progress monitored and corrective action taken when problems arise.

Employee participation in safety issues is also important. Workers are in close collaboration and consultation with safety delegates, employers and the regulator. The Petroleum Safety Authority Norway was created on January 1, 2004 as an independent Government regulator. It is composed of the former Petroleum Directorate safety department and has extended authority to cover supervision of safety,

emergency preparedness and the working environment for petroleum-related plants on land and associated pipeline systems as well. A new and unified regulatory framework for health, safety and environment are to come into force on January 1, 2011 (Petroleum Safety Authority Norway, 2010).

Response to the Macondo Spill

In June, 2010, Norway's energy minister Terje Riis-Johansen said it was "not appropriate" to allow new deepwater drilling until the Macondo incident had been fully investigated, but also stated that it would still award new exploration licenses in its territorial waters next year. The minister wanted "more knowledge" about what had happened in the Gulf of Mexico and what it meant for Norway's regulatory regime before the country handed out more deepwater licenses (Moskwa & Wynn, 2010).

3.7.2 United Kingdom

Performance-based regulation in the United Kingdom oil and gas industry began in 1988 when the *Piper Alpha* platform caught fire and sank in the North Sea, killing 167 people. This catastrophe was characterized as the most deadly disaster in offshore oil-industry history. Indeed, the safety case concept for offshore oil and gas operations began soon thereafter to replace the prescriptive approach. U.K. standards describe objectives, and operators can select the methods and equipment used to achieve these objectives and meet the statutory obligations. Approved codes of practice and guidance documents complement the safety case regulations.

Lord Cullen, who led the public inquiry and developed recommendations to prevent recurrence of such a disaster, rejected a prescriptive approach and developed comprehensive objectives and made 106 specific recommendations to initiate a new and improved safety regime. The outcome was that by 2001, offshore industry accidents had declined more than 75% (National Energy Board, 2009). To quote both Lord Cullen and the work of Bob Vergette of the NEB; "The Lord Cullen report reassured all stakeholders - the oil industry, the UK Government and its citizens - that offshore oil and gas operations could be conducted safely if a rational, goal-oriented approach were implemented, together with effective application of technology and stringent inspection procedures (National Energy Board, 2009)."

In the U.K., the Department of Energy and Climate Change (DECC) is responsible for energy policy, and the Health and Safety Executive (HSE) regulates work-related health, safety and illness in the offshore. The core activities of HSE are safety case assessment, verification, inspection, investigation, and enforcement. The approval process for the HSE is case-specific and each case must be accepted and approved before the offshore installation operates. A Government inspectorate is in place as an assurance mechanism. The HSE oversight includes over 300 installations including, production platforms, Floating Production Storage and Offloading units, and mobile offshore drilling units.

In 1992, the Offshore Installation (Safety Case) Regulations were introduced into the U.K. sector. These require all fixed and mobile offshore installations operating in U.K. waters to have a safety case that must be reviewed and approved by the Health and Safety Executive.

Response to the Macondo Spill

On June 7, 2010 the United Kingdom energy regulators stated that it will double offshore rig inspections in the wake of the Macondo incident in the Gulf of Mexico. The Department of Energy and Climate Change (DECC) is conducting a review with the intention of further strengthening its regime. Whereas the existing system is said to be “fit for purpose,” new inspectors will be hired with a goal of doubling inspections. In addition, the DECC is reviewing the indemnity and insurance requirements for operators on the U.K. continental shelf.

Oil and Gas U.K., the industry trade association, has established a new group composed of regulators and oil companies to study the response to a Gulf-like incident. The group is known as the Oil-spill Prevention and Response Advisory Group (OSPRAG). The U.K. Energy Minister Charles Hendry said “the Deepwater Horizon gives us pause for thought and given the beginning of exploration in deeper waters west of Shetland, there is every reason to increase our vigilance”. The OSPRAG will provide direction and support to four specialist review groups focusing on:

- technical issues, including first response for protection of personnel
- oil-spill response capability and remediation including national emergency response measures
- indemnity and insurance requirements
- pan-North Sea regulations and response mechanisms

Mark McAllister, the Chair of the steering committee, said: “A good start has been made this week, but there is a great deal of work to be done. We are going to be rigorous in our testing and questioning of what we have in place here in the U.K., not because we think our practices and procedures are not up to standard but because we cannot be complacent in the face of what is happening in the Gulf of Mexico. The tragic events there compel us to look afresh at what we do and how we operate; we have to prove to ourselves, and to the world at large, that we are managing risk in a comprehensive and fully informed manner”(Oil and Gas UK, 2010).

3.7.3 Australia

The organization responsible for regulating safety in Australia’s oil and gas industry is the National Offshore Petroleum Safety Authority (NOPSA), an independent statutory agency designated under the Commonwealth *Offshore Petroleum and Greenhouse Gas Storage Act 2006*. NOPSA implements a

performance-based regulatory approach where the regulator is responsible for providing assurance that the operators address risks identified by a safety case. The organization includes a joint Government inspectorate and requires third-party validations for regulatory assurance. Each manned facility is inspected at least once a year. The inspections are planned and usually take several days. The focus of these inspections includes both control and management of major equipment and occupational health and safety.

The primary features of the Australian regulatory system are:

- Duties of care - Specific categories of persons (operators, employers, etc.) who are involved in offshore petroleum activities at facilities are required to “take all reasonably practicable steps” to protect the health and safety of the facility workforce and of any other persons who may be affected.
- Consultation provisions - Mechanisms are set out that will enable effective consultation between each facility operator, relevant employers, and the workforce regarding occupational health and safety.
- Powers of inspectors - Inspectors are granted powers to enter offshore facilities or other relevant premises, conduct inspections, interview people, seize evidence and otherwise take action to ensure compliance by parties with legal obligations.

Standards and best practices are based on a safety case approach, similar to that specified in the U.K. regulatory system.

Response to the Macondo Spill

The Australian Government is in the process of drafting legislation for tighter oversight of its offshore drilling industry in the wake of the blowout and spill at the Montara well in the Timor Sea.

The 2009 blowout had less than one tenth the flow of the Macondo well, was in much shallower water and took 73 days to kill. The Montara oil well had no BOP on the seafloor because regulators and operators felt it to be unnecessary. The resulting spill was Australia’s third worst, after tanker-spills in 1975 and 1991. After five relief-well attempts and ten weeks later, the spill was killed.

The commission of inquiry into the Montara spill was originally scheduled to issue its report in May 2010 but has delayed its release until June 18, 2010. The findings will not be made public now, until the Macondo investigation has concluded.

The Australian Resources Minister Martin Ferguson has received the findings of the report and said he will “act promptly to release the report after reviewing the findings and ensuring its public release won’t

prejudice any further investigations into possible criminal offences or civil action. Australia must revisit its regulation of oil and gas companies, making one agency responsible for safety, the environment and well operations. While the Montara spill in 2009 and the recent Macondo spill have damaged confidence in the industry, new oil discoveries are necessary as the nation's reliance on imports increases. However, the importance of security of supply is no excuse for sub-standard safety and environmental performance" (Paton & Daley, 2010).

3.7.4 United States

The Macondo incident is having a significant impact on how the U.S. will deal with its oversight and regulatory practices. Ken Salazar, the Interior Secretary has made major changes to regulations and ordered the breakup of the Minerals Management Service to bolster its focus on safety. There will be three independent agencies:

- The Bureau of Ocean Energy Management, which will oversee offshore leases;
- The Bureau of Safety and Environment Enforcement, which is charged with assuring safe drilling and production operations within U.S. waters; and
- The Office of Natural Resources Revenue, which will collect fees and royalties.

(Note: The Bureau of Ocean Management and the Bureau of Safety and Environment Enforcement will remain under the Department of the Interior. The U.S. is effectively now doing what Canada and Newfoundland and Labrador have been doing all along in relation to its offshore petroleum activity).

The MMS recently prepared a report entitled "Increased Safety Measures for Energy Development on the Outer Continental Shelf" that recommends a series of steps to immediately improve the safety of offshore oil-and gas-drilling operations in Federal waters (U.S. Department of the Interior, 2010). They are a set of interim recommendations based upon what is known about the equipment, systems, and practices necessary for safe operation. There are a number of specific measures designed to ensure sufficient redundancy in the BOP's, to promote the integrity of the well and enhance well-control and to facilitate a culture of safety through operational and personnel management. Recommended actions include prescriptive near-term requirements, longer-term performance-based safety measures, and one or more Department-led working groups to evaluate longer-term safety issues. The recommendations take into account that drilling activities conducted in the deepwater environment create increased risks and challenges.

Key recommendations on BOP's and related equipment used on floating drilling operations, as taken directly from the MMS report, include:

- Mandatory inspection of each BOP to be used on floating drilling operations to ensure that the BOP:
 - i. meets manufacturer design specifications, taking into account any modifications that have been made;
 - ii. is compatible with the specific drilling equipment on the rig on which it is to be used, including that the shear ram is compatible with the drill pipe to be used;
 - iii. has not been compromised or damaged from previous service;
 - iv. is designed to operate at the planned operating depth. Certification of these requirements will be made public.
- Requirement of new safety features on BOP's and related backup and safety equipment including:
 - i. a requirement that BOP's have two sets of blind shear rams spaced at least four feet apart to prevent BOP failure if a drill pipe or drill tool is across on the rams during an emergency;
 - ii. requirements for emergency backup control systems;
 - iii. requirements for remote operating vehicle capabilities. The Department will develop new surface and subsea testing requirements to verify reliability of these capabilities.
- Overhaul of the testing, inspection and reporting requirements for BOP and related backup and safety equipment to ensure proper functioning, including new means of improving transparency and providing public access to the results of inspections and routine reporting.

Key recommendations on well-control systems, as taken directly from the MMS report, include:

- Development of enhanced deepwater well-control procedures.
- Verification of a set of new safeguards that must be in place prior to displacement of kill-weight drilling fluid from the well-bore.
- New design, installation, testing, operations, and training requirements relating to casing, cement or other elements that compromise an exploratory well.
- A comprehensive study of methods for more rapid and effective response to deepwater blowouts.

Key recommendations on a systems-based approach to safety, as taken directly from the MMS report, include:

- Immediate, enhanced enforcement of current regulations through verification within 30 days of compliance with the April 30, 2010, National Safety Alert.
- Enhanced requirements to improve organizational and safety management for companies operating offshore drilling rigs.
- New rules requiring that offshore operators have in place a comprehensive, system-based approach to safety and environmental management.

The Secretary also recommended a six-month moratorium, and an immediate halt to drilling operations on 33 permitted wells. The moratorium has since been overturned by the U.S. Court. An appeal is pending (US Department of the Interior, 2010).

A summary of the specific regulatory recommendations are provided in Table 7. The recommendations are explained in Appendix XVI, as taken directly from the MMS report. The recommendations provide insight into the upcoming changes to the U.S. regulatory regime. The numbering of the recommendations has been altered to provide clarity when referencing Table 7.

3.7.5 Canadian Comparison

Canada, being influenced by the approach taken by Norway, Australia and the U.K., adopted a unique hybrid approach of Goal-Oriented Regulation. Goal-oriented regulations are a mix of prescriptive and goal-based styles of regulation. They contain sections that provide prescription where deemed necessary and provide for latitude in the achievement of certain targets or results where appropriate. The Canada-Newfoundland Offshore Petroleum Board (C-NLOPB) is responsible for the regulation of petroleum activities offshore Newfoundland and Labrador. The Canada-Nova Scotia Offshore Petroleum Board (C-NSOPB) is responsible for regulation of petroleum activities offshore Nova Scotia. Their principle responsibilities include ensuring health and safety for offshore workers, protection of the environment, conservation of offshore petroleum resources, compliance with legislative provisions regarding employment and industrial benefits, issuance of licenses for offshore exploration and development, and resource evaluation. Both Boards are independent joint agencies of the Government of Canada and their respective Provinces. Each work activity proposed in the offshore area related to exploration, drilling, production, conservation, processing, or transportation of petroleum requires the authorization of the responsible Board. Assurance mechanisms include Board inspections, audits and investigation programs, and industry self-inspections. Operators are required to submit reports detailing the status of their work programs on an ongoing basis, along with other documentation to demonstrate compliance with regulatory requirements.

Table 7 - Summary of US Regulatory Recommendations

Main Area	Sub-Area		No.	Recommendations
I) BOP Equipment and Emergency Systems	A) Certification of Subsea BOP Stack		1	Order Immediate Re-certification of All BOP Equipment Used in New Floating Drilling Operations
			2	Order BOP Equipment Compatibility Verification for Each Floating Vessel and for Each New Well
			3	Develop Formal Equipment Certification Requirements
	B) New Safety Equipment Requirements and Operating Procedures		4	New Blind Shear Ram Redundancy Requirement
			5	Secondary Control System Requirements and Guidelines
			6	New ROV Operating Capabilities
	C) New Testing Guidelines and Inspection Procedures		7	Develop New Testing Requirements
			8	Develop New Inspection Procedures and Reporting Requirements
II) Procedures to Ensure Adequate Physical Barriers and Well-control Systems are in Place to Prevent Oil and Gas from Escaping into the Environment - Minimizing Risk of Uncontrolled Flow	A) Well-Control Guidelines and Fluid Displacement Procedures		9	Establish Deepwater Well-Control Procedure Guidelines
			10	New Fluid Displacement Procedures
	B) Well Design and Construction	1) Requirements for Both Casing and Cementing	11	New Casing and Cement Design Requirements: Two Independent Tested Barriers
			12	Study Formal Personnel Training Requirements for Casing and Cementing Operations
		2) Casing Requirements	13	New Casing Installation Procedures
			14	Develop Additional Requirements or Guidelines for Casing Installation
		3) Cementing Requirements	15	Enforce Tighter Primary Cementing Practices
			16	Develop Additional Requirements or Guidelines for Evaluation of Cement Integrity
	C) Wild-Well Intervention		17	Increase Federal Government Wild-Well Intervention Capabilities
			18	Study Innovative Wild-Well Intervention, Response Techniques, and Response Planning
III) Organizational and Safety Management	A) Increased Enforcement of Existing Safety Regulations and Procedures Enforcing Existing Regulations		19	Compliance Verification for Existing Regulations and April 30, 2010, National Safety Alert
	B) Organizational Management Organizational Safety Case Documentation		20	The Department Will Adopt Safety Case Requirements for Floating Drilling Operations on the OCS
	C) Personnel Accountability Procedures for Operational Safety (Risk, Injury, and Spill Prevention)		21	Finalize a Rule that Would Require Operators to Develop a Robust Safety and Environmental Management System for Offshore Drilling Operations
			22	Study Additional Safety Training and Certification Requirements

Source: Modified from (US Department of the Interior, 2010)

Many countries and regulators admit that moving from a prescriptive regulatory structure to one where the details of how to comply with the regulations are increasingly the responsibility of the regulated entity results in more effective regulation. Goal-oriented regulations permit flexibility, good judgment and experience to determine the most cost-effective and efficient solutions to protect people, property and the environment. Advantages to both industry and regulators include: efficient and effective resource allocation, performance measurement, and transparency of information to maintain public trust. Advantages for industry include: flexibility to adapt to new standards and technology, ability to use multiple risk reduction strategies and responsibility for compliance.

The Canada Gazette provided a very accurate overview of the goal-oriented approach (Canada Gazette, 2009).

“Regulation continues to be required to ensure that activities related to the drilling for, or production of, oil and gas are carried out in a manner that is safe, protects the environment and ensures that resources are not wasted”.

“The regulations address three main issues. First, the Standing Joint Committee on the Scrutiny of Regulations requested that the regulators address the high level of duplication between the Drilling Regulations and the Production and Conservation Regulations”.

“Second, the prescriptive nature of the regulations had created increased administrative challenges and costs that affected regulatory efficiency and effectiveness. Regulators observed increased numbers of requests from companies to use new or cost-effective technologies and processes not reflected in the regulations. The flexibility to develop more efficient and effective regulatory processes was limited by the existing regulations, which contained prescriptive and detailed information requirements specifically regarding the number of copies and timing of applications and specific reference to authorized activities. Further, while not currently exercised, the Acts allow authority to be given to the Boards, through regulation, to deal with certain production matters by way of an order”.

“Lastly, advances in research into the causes of accidents (injuries and spills) and approaches for effective risk management for safety and environmental protection have led to the development of management systems-based models that are increasingly used to better manage risks in international jurisdictions and by industry”.

3.7.6 Amalgamation and Modernization

Amalgamation and modernization of drilling and production regulations are briefly discussed in Section 2.3. There are six main areas of change as a result of amalgamation and modernization:

- 1) The Drilling Regulations and Production and Conservation Regulations are amalgamated and updated into a single Drilling and Production Regulations.
- 2) The Regulations have been written in a goal-oriented style that combines goal-based, performance-based and prescriptive elements, depending upon the circumstances.
- 3) The Regulations require companies to have a management system to ensure compliance with the Regulations and the Act.
- 4) The Regulations have been updated to align with current regulatory drafting approaches and standards.
- 5) The Regulations provide improved flexibility to develop regulatory process efficiencies, including providing the Boards with the authority to deal with well spacing and associated production matters by way of an Order.
- 6) Consequential amendments to the Installation Regulations and the Certificate of Fitness Regulations under the Acts are made.

Source: Drilling and Production Regulations, 2010

The Regulations are predominantly operational and technical in nature. The primary topics in the Regulations include safety, appropriate conservation of the hydrocarbon resource and the protection of the environment during activities undertaken for the drilling and production of oil and gas. The Regulations also outline the information that must accompany regulatory applications as well as identify specific reporting requirements.

The regulations do not alter existing environmental screening and assessment processes that may apply to proposed drilling or production projects, such as the Canadian Environmental Assessment Act, the Mackenzie Valley Resource Management Act, the Inuvialuit Final Agreement, the Labrador Inuit Land Claims Agreement and the Nunavut Land Claims Agreement.

Goal-oriented regulation is a hybrid approach that includes prescriptive and goal-or performance-based elements. Prescriptive regulation dictates the means by which compliance is achieved; including what is to be done, by whom and how it is to be accomplished. Goal-or performance-based regulation sets regulatory goals or performance objectives to be achieved and allows companies to identify the means to meet them.

Since the development of the existing regulations, the frontier and offshore oil and gas industry has been exploring for, and planning to exploit hydrocarbons from, more technologically complicated and physically challenging environments having more varied hazards and risks. Advancements in equipment, techniques, safety management and environmental management have also occurred.

Prescriptive regulations, by their nature, are written to address a specific set of circumstances and generally cannot address each circumstance, activity and facility design that may create hazards and that should be managed.

A prescriptive approach is also unable to adapt quickly to technological changes and improvements to best practice. Changes relating to outdated requirements must be affected through regulatory amendment. Alternatively, operators must apply, pursuant to the Acts, for exemption from, or equivalency to, specific provisions in the Regulations. However, the Acts restrict exemptions to requirements related to equipment, methods, measures or standards.

The goal-oriented approach retains the regulatory objectives of safety, protection of the environment and conservation of resources while enhancing regulatory clarity and efficiency. The majority of the Drilling and Production Regulations are written in a goal-or performance-based style having clear regulatory objectives or goals. The prescriptive elements are present in the management system elements (Section 5 - Drilling and Production Regulations), information requirements for reporting (Part 11 - Drilling and Production Regulations) and information requirements related to applications for authorizations and well approvals (Part 2 - Drilling and Production Regulations).

The Regulations include a requirement for companies to develop and implement a management system to ensure compliance with the Act and the Regulations (Sections 6, 18 and 102 [103 in the *Accord Act* Version]). These systems ensure that companies have documented policies and procedures for how they carry out their activities while ensuring compliance and safety, environmental protection and conservation of resources.

The management system components (Section 5 - Drilling and Production Regulations) include processes to set policies and performance objectives, proactively identify hazards, evaluate risk and identify mitigation, establish clear responsibilities and accountabilities, have trained and competent personnel and establish systems of document management, reporting, evaluation and continual improvement.

The inclusion of management systems requirements strengthens the existing regulatory framework and is more consistent with other international jurisdictions and with other high-hazard industries. In particular, human and organizational factors are systematically addressed, complementing the technical and equipment aspects in the Regulations. Further, it ensures that companies proactively evaluate the project-

specific hazards and risks and identify the most appropriate technology, design and operational requirements for the circumstances.

In the Drilling and Production Regulations, the Government's role in management of safety, environmental protection and prevention of waste, shifts from prescribing how companies must operate to identifying clear regulatory goals and objectives while ensuring that companies have processes in place to effectively identify and manage safety and environmental issues through the lifespan of each project from planning through decommissioning.

Management systems for safety and environmental protection are well established in industry both in Canada and internationally. There are several recognized international and Canadian standards specific to the design and implementation of quality, safety and environmental management systems. The Norwegian, British and Australian oil and gas regimes all have management-systems-based regulatory requirements related to hazard identification and risk management. In Canada, the Safety Management System Regulations were implemented under Canada's *Railway Safety Act* in 2001 and safety management system requirements were added to the Civil Aviation Regulations in 2005. The National Energy Board's goal-oriented Onshore Pipeline regulations, 1999, include requirements related to all essential management systems elements.

The Drilling and Production Regulations recognize that the management system should correspond to the size, nature and complexity of the operators operations, activities, hazards, and risks associated with the operations. Arrangements coordinating the management and operations of the proposed work or activity among owners of installations, contractors, the operator and others, as applicable, must also be in place.

The shift to goal-oriented Regulations reduces much of the current volume of operator requests for exemptions or equivalencies that stem from outdated or non-applicable prescriptive requirements in the regulations.

Canada is committed to the development of frontier and offshore energy resources in a safe, economically competitive, environmentally and socially responsible manner to the mutual benefit of all stakeholders.

The Regulations will, for drilling and production activities, resolve regulatory duplication, move from a prescriptive to a goal-oriented style, incorporate a management systems approach, facilitate regulatory process improvements and reduce the administrative burden.

3.8 Additional Roles in Oil-spill Prevention

3.8.1 International Regulators Forum

Oil and gas companies are international organizations that deal with numerous regulating bodies throughout the world. To better coordinate safety within the oil and gas industry, the International Regulators Forum (IRF) was created in 1994. The IRF have coordinated national offshore regulating bodies to help improve the industries health and safety standards and performance worldwide. Table 8 provides a list of the regulating bodies and associated countries in the IRF.

Table 8 - International Regulators Forum Participants

Acronym	Agency	Country
NOPSA	National Offshore Petroleum Safety Authority	Australia
PSA	Petroleum Safety Authority	Norway
MMS	Mineral Management Service	United States
DOL	Department of Labour	New Zealand
C-NSOPB	Canada-Nova Scotia Offshore Petroleum Board	Canada
C-NLOPB	Canada-Newfoundland and Labrador Offshore Petroleum Board	Canada
ANP	National Petroleum Agency	Brazil
HSE	Health and Safety Executive	Great Britain
SSM	State Supervision of Mines	Netherlands

Source: (International Regulators Forum, 2010)

There are several objectives of the IRF. The main goal of the forum is to promote safe global practices in the offshore industry that coincide with the best economic practices. The forum also looks to exchange valuable information between countries, including health and safety trends, safety performance, lessons learned, best practices, regulatory practice and regulatory effectiveness (International Regulators Forum, 2010). Finally, the IRF looks to develop an open network between regulators to aid with support and advice when these circumstances are required.

The IRF looks to achieve their objectives through a number of different measures. Each year, an annual meeting is held to cover health and safety issues, country updates and relevant technical issues. Communication also occurs between members throughout the year when necessary. Program working groups are created to advance issues deemed important by the IRF participants. As well, conferences are held to share lessons learned and compare regulatory approaches and safety performance. Finally, outreach initiatives of the member countries and active maintenance of the IRF website help promote global safety throughout the industry (International Regulators Forum, 2010).

The IRF releases a number of performance measures related to health, safety and environmental performance for each of the participating nations. Data provided on the IRF website provides several safety measures for 2007 and 2008. Figure 15 through Figure 17 provide comparisons of fatalities, less than major loss of well-control and major loss of well-control.

Note the total number of well activities for Brazil in 2007 was not provided. Therefore the percentage is based on the number of well activities in 2008, assuming the numbers remain nearly constant.

The figures show most losses of well-control, both major and less than major, have occurred in the United States. The numbers are generated per 100 well activities to normalize the comparison between nations with respect to the industry size.

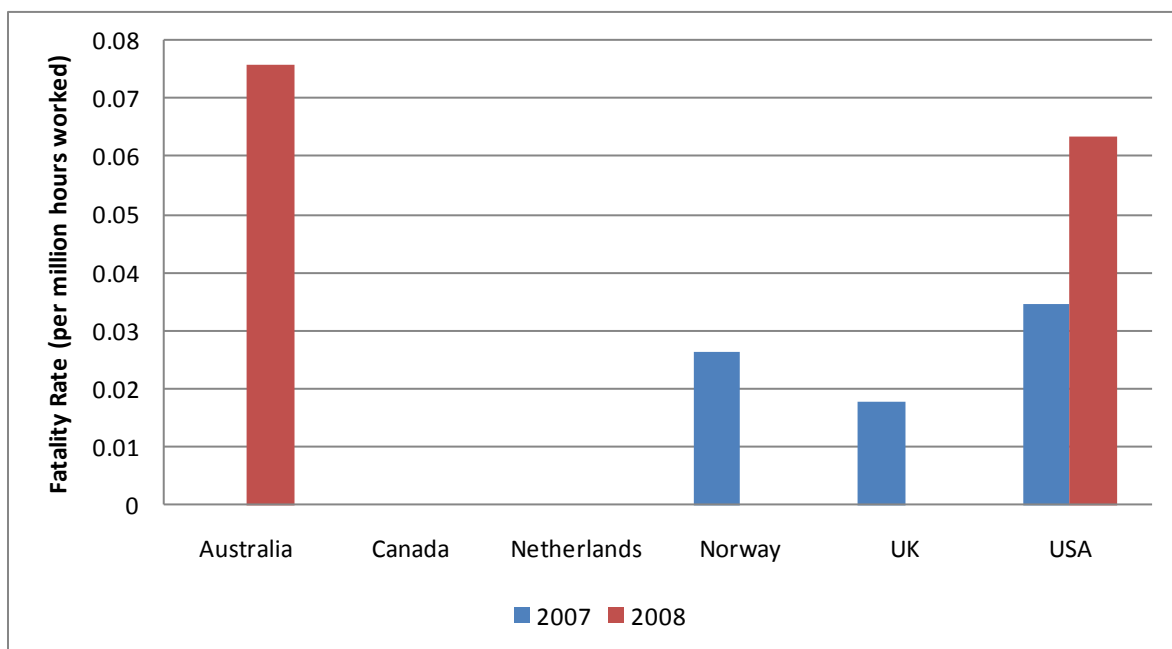


Figure 15 - Fatality Rate Comparison between IRF Members

Source: (International Regulators Forum, 2010)

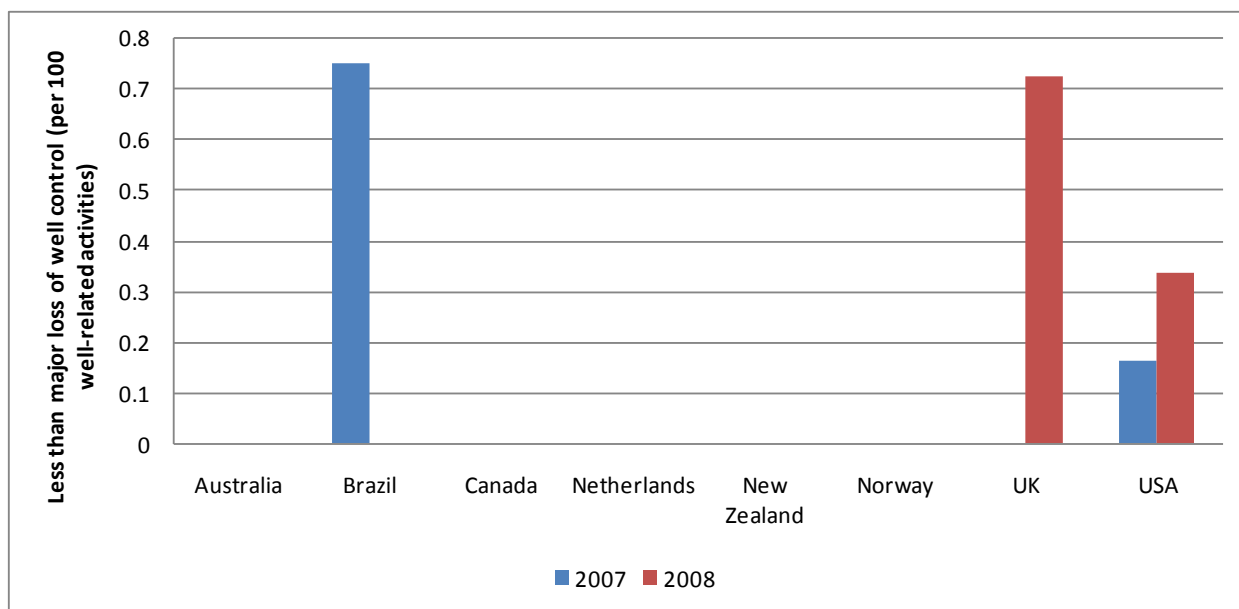


Figure 16 - Less than Major Loss of Well-control Comparison between IRF Members

Source: (International Regulators Forum, 2010)

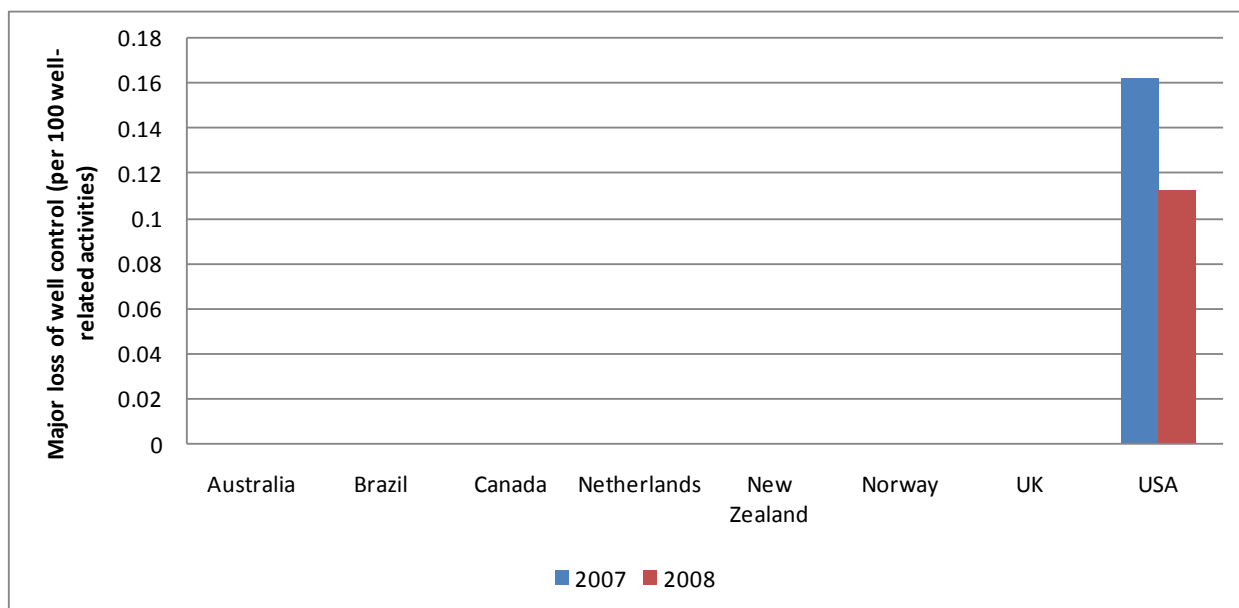


Figure 17 - Major Loss of Well-control Comparison between IRF Members

Source: (International Regulators Forum, 2010)

3.8.2 Provincial and Federal Government

It is the ultimate responsibility of the Provincial and Federal Governments to obtain maximum local benefits for offshore resources, in addition to protecting the safety of workers and the environment

through legislation. The direct role in regulating petroleum operations and health and safety has been given to the C-NLOPB. This allows the Board to regulate on behalf of the Provincial and Federal Governments. The role of the C-NLOPB has been explained thoroughly. The Provincial Government, through the Department of Natural Resources, is responsible for establishing and administering the fiscal regime for offshore activities, but this is largely unrelated to prevention.

Both levels of Government are responsible for the establishment of the current system, and as such have the right to propose changes to the systems should a need arise. This report, as well as other investigations such as the helicopter inquiry, shows the role of Government in ensuring the current regimes are effective and fulfilling their obligations in the best possible manner. Should deficiencies be found, both levels of Government may propose changes to better adapt the current regime.

Many of the additional regulatory regimes responsible for safety in the offshore are federal subsidiaries. These include Transport Canada, The Canadian Coast Guard, The Canadian Environmental Assessment Agency and the National Energy Board.

3.8.3 Local Government Involvement

The municipal Governments within Newfoundland and Labrador have little to no direct involvement in the prevention of spills in oil and gas industry. In comparison to other areas of the world, the Newfoundland and Labrador oil industry is rather small. Whereas there are numerous positive impacts on the local economy in terms of revenue and job growth, the municipal Governments have no ability to regulate new or current oil developments beyond issues relating to onshore, in city operations. Oil-spill prevention is predominately regulated by the C-NLOPB and the CCG, who represent the best interests of all people in the Province, including those of the respected municipalities.

3.8.4 Canadian Association of Petroleum Producers

The Canadian Association of Petroleum Producers (CAPP) is an organization representing petroleum production companies throughout Canada. CAPP works as a third party between the petroleum producers and Government or other stakeholders. The organization works in the best interest of its members throughout negotiating processes and acts as a unified voice for the industry. Members of CAPP have access to various industry information, research work through CAPP's Environmental Research Advisory Council (ERAC) and Basic Safety Programs among the additional resources (CAPP, 2010). CAPP, through its member companies, also works as a channel for media support, information and opportunities, and have acted as the main line of communication between the operators and the authors of this report. Various companies represented by CAPP in the Newfoundland and Labrador offshore oil and gas industry

include ExxonMobil, Suncor Energy, Chevron and Statoil. Husky Energy, operator of White Rose, has yet to become a member.

As stated in numerous publications by CAPP, the primary focus of operations in Atlantic Canada in the context of oil-spills is prevention. A list of spill-prevention initiatives used by CAPP drilling and production facilities, as provided in CAPP's Spill Prevention and Response brochure, is as follows:

- 1) Specialized equipment, including BOP's
- 2) Well-control and safety equipment, including heavy-duty piping, subsurface safety valves, fire and gas detection, and deluge systems
- 3) Spill-prevention devices and drainage systems
- 4) Risk assessments to ensure design and equipment integrity
- 5) Quality assurance and quality control programs
- 6) Emergency shut-down equipment throughout the facilities
- 7) Third-party reviews and assessments
- 8) Training and competency assessment of personnel
- 9) Operational techniques incorporating industry best practices
- 10) Health, safety and environmental management systems
- 11) Ice and harsh weather prediction and management

Note that operating companies in the Newfoundland and Labrador offshore represented under CAPP include ExxonMobil and Suncor. Husky, the operator of the White Rose field, is not a member.

Section 4 - Oil-spill Response and Remediation in Newfoundland and Labrador

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4.0 Oil-spill Response and Remediation in Newfoundland and Labrador

4.1 Legislative and Regulatory Regimes

4.1.1 Canada-Newfoundland and Labrador Offshore Petroleum Board

Offshore oil and gas operators are required by law to develop spill-response plans as part of their approval and permitting process. These plans include detailed descriptions on how companies prevent spills and how they would respond to a variety of spill scenarios in exploration, development and production phases. Offshore operators must also have equipment and trained personnel prepared to respond to an incident both on the drilling location and on shore based facilities.

Offshore operators are also obligated to work closely with spill specialists and authorities to develop spill-response strategies. The first response would be to shut down the source of the spill. The size and the trajectory of the spill would be assessed and monitored by using specialized detection equipment and all appropriate materials would be mobilized to mount an appropriate response.

Response mechanisms available to Atlantic Canada operators include:

- Oil-spill response equipment such as containment booms, skimmers, tracking devices are permanently stored on production facilities and on supply vessels. Additional equipment is stored on shore in Donovan's Industrial Park, Mount Pearl, NL, and can be quickly mobilized to the incident location;
- Spill-response contractors Eastern Canada Response Corporation (ECRC) are available 24 hours a day to provide assistance. Oil-spill response Ltd., the world's largest spill-response organization can also provide assistance within 24 hours; Other Canadian RO's are also available to lend equipment and assistance. Appendix XI outlines the various equipment possessed by the ECRC;
- Many operators have special teams ready to be mobilized within hours to augment local response organizations;
- The Canadian Coast Guard, which has the largest inventory of pollution recovery equipment in Canada, is readily available with personnel and spill equipment; and
- Through mutual aid agreements, offshore operators and companies will provide spill-response support by lending equipment and allocating personnel to other offshore facilities, if needed.

The operator's emergency-response plan is a detailed plan that guides the actions of workers and contractors if an emergency occurs. Such plans require that workers have the proper training enabling them to make the right decisions and take the right actions when they have to react to an emergency.

Emergency-response plans also identify sources of extra support, specialized expertise and resources that may be needed for an emergency. As well, this approach ensures that companies quickly notify the proper Government agencies and advise fishing vessels in the area of an incident.

Offshore operators design these plans to first protect people and the environment and then minimize damage to equipment and facilities. The plans cover an exhaustive list of potential situations, including:

- Fatalities, serious injuries and medical emergencies;
- Missing persons, including man overboard;
- Diving emergencies;
- Loss of control of a well;
- Fires and explosions;
- Oil or hazardous material spills;
- Damage to drilling rigs, production platforms, support vessels and aircraft;
- Vessel collisions with drilling rigs or production platforms;
- Presence of heavy sea-ice or icebergs;
- Extreme weather, including sea state, wind, icing; and
- Missing or downed helicopters.

Offshore operators can look for help to other companies, contractors, the Canadian Coast Guard and international spill-response organizations, if needed. Many offshore oil and gas companies also have an agreement to use the equipment and expertise of the Eastern Canada Response Corporation.

When an offshore oil and gas project is first proposed, operators must plan, identify and analyze potential risks to people and the environment. Procedures are put in place to reduce or eliminate identified hazards, train workers to recognize and respond to potential emergencies and monitor and repair equipment before failures occur.

All offshore oil and gas operators in offshore Newfoundland and Labrador are required by law to have comprehensive emergency response plans and procedures in place before the C-NLOPB authorizes their activities. Nevertheless, human error or equipment failure can, on occasion, lead to a spill, hence the need for redundancies. At this point, an extensive emergency-response plan is activated to protect people and minimize damage to the environment.

4.1.2 Transport Canada and The Canadian Coast Guard

Between 1991 and 1993, the Canadian Coast Guard (CCG) and Environment Canada exercised considerable planning with consultation with the private sector, on the development of the two main elements of a private-sector funded response capability for ship-source spills.

The *Canada Shipping Act (CSA)* had to be amended to create the legislative framework in order to make the industry Government relationship work. In August 1995, the regulations were approved by the Minister of Fisheries and Oceans allowing the CSA amendments to be proclaimed. At about this time, responsibility for managing the newly-founded National Oil Spill Preparedness and Response Regime was transferred to Transport Canada.

Potential polluters have a legal responsibility, entrenched in the CSA, to undertake preparedness measures and to pay for repairing or mitigating damage to the marine environment. Ships and designated oil-handling facilities are required to have an arrangement in place with government-certified response organizations (RO). RO's are Canadian-based, private sector organizations that must earn their certification from the Federal Government by demonstrating their ability to effectively prepare for and respond to marine oil-pollution incidents.

4.2 Canada's Marine Oil-spill Preparedness and Response Regime

Transport Canada is the lead federal regulatory agency responsible for the regime, which was established in 1995 and is built on a partnership between Government and industry. Within the framework of the regime, Transport Canada sets the guidelines and regulatory structure for the preparedness and response to marine oil-spills.

4.2.1 Guiding Principles

The guiding principles for the regime are:

- Effective and responsive legislation;
- Potential polluters pay for preparedness;
- Polluter pays for reasonable response costs;
- Based on partnership with industry;
- Comprehensive contingency plans; and
- Mutual agreements with neighbors.

Canada's Marine Oil-spill Preparedness and Response Regime is based on the Polluter-Pays-Principle. The polluter is typically called upon to manage the response to a spill when it occurs and appoints an On-scene Commander (OSC). The response organizations provide the response required to manage and clean-up the spill and the CCG monitors the overall response to ensure that it is effective, timely and appropriate to the incident. The Regional Environmental Emergencies Team (REET) advises the On-scene Commander on environmental priorities and on scientific and other regional concerns related to the incident. The CCG would become the OSC during an incident if the polluter is unable to respond, is unwilling to take action or is unknown.

4.2.2 Polluter-Pays-Principle

Simply put the Polluter-Pays-Principle (PPP) is an environmental policy principle that requires that the costs of pollution be borne by those who cause it.

“...the polluter should be held responsible for environmental damage caused and bear the expenses of carrying out pollution prevention measures or paying for damaging the state of the environment where the consumptive or productive activities causing the environmental damage are not covered by property rights.” This is the extended version of the PPP (The Encyclopaedia of Earth, 2010).

The principle was initially introduced at the international level in the 1972 recommendation by the Organization for Economic Co-operation and Development (OECD) Council on Guiding Principles Concerning International Economic aspects of Environmental Policies, where it was stated. “The principle to be used for allocating costs of pollution prevention and control measures to encourage rational use of scarce environmental resources and to avoid distortions in international trade and investment is the so called Polluter-Pays-Principle. This principle means that the polluter should bear the expenses of carrying out the above mentioned measures decided by public authorities to ensure that the environment is in an acceptable state.”

There are four identified versions: economically, it promotes efficiency; legally, it promotes justice; it promotes harmonization of international environmental policies; it defines how to allocate costs within a state. “The principle of polluter pays in economics and law” (Bugge H.C, 1996).

Canada applies the Polluter-Pays-Principle. Oil-spill preparedness and response is funded and operated by the private sector and was established in 1995 enabling industry to respond to its own spills up to 10 000 tonnes. The CCG owns significant response equipment to compliment the regime. They also apply certification standards for industry clean-up operations, which offers effectiveness to the regime.

Canada has a strong record of environmental protection. Of significance was the December 2003 decision handed down by The Canadian Supreme Court upholding the Government’s policy requiring polluters to pay for the cost of clean-up, creating a new and important precedent that influences business practices and activities by forcing companies to exercise more stringent environmental safeguards. It was cited that the Polluter-Pays-Principle is “firmly entrenched” throughout international, federal, and provincial environmental laws (Gowling Lafleur Henderson LLP, 2003).

The Court further noted and explained the principle as follows: “ To encourage sustainable development, that principle assigns polluters the responsibility for remedying contamination for which they are responsible and imposes on them the direct and immediate costs of pollution. At the same time, polluters are asked to pay more attention to the need to protect the ecosystems in the course of their economic activities” (Gowling Lafleur Henderson LLP, 2003).

Canada therefore, like other countries, is committed to the Polluter-Pays-Principle through decisions of the OECD and the 1992 Rio Declaration and is an economic principle for sustainable development.

4.2.3 Transboundary Planning

Canada also participates in joint activities with the United States in an effort to establish an appropriate measure of preparedness and response. A formal Canada - US Joint Marine Pollution Contingency Plan has been established.

4.2.4 Legislation and Conventions

The Canadian legislation that governs the regime is:

- *Canada Shipping Act*;
- Dangerous Chemicals and Noxious Liquids Substances Regulations;
- Oil-Pollution Prevention Regulations;
- Pollutant-Discharge Reporting Regulations;
- Response Organization and Oil-Handling Facilities Regulations;
- *Canada Shipping Act 2001*;
- *Arctic Waters Pollution Prevention Act*;
- *Oceans Act*; and
- *Fisheries Act*.

Canada is also an active member of the International Maritime Organization and has acceded to a number of international conventions that support the regime:

- International Convention for the Prevention of Pollution from Ships (MARPOL 73/78);
- International Convention on Oil-Pollution Preparedness, Response and Cooperation (OPRC 90);
- International Oil-Pollution Compensation Fund;
- Civil Liability Convention; and
- Salvage Convention.

4.2.5 Spill-response Procedures

The following information is provided courtesy of Transport Canada. In the event of a spill, the following procedures should be followed:

- 1) Report the incident to the closest regional Canadian Coast Guard station;
- 2) In the event of a ship or an oil-handling facility incident, the polluter would report the incident as required under the *Canada Shipping Act* regulations. The polluter would appoint an On-Scene Commander. This is usually pre-identified in their oil pollution emergency plan or shipboard oil pollution plan;

- 3) The designated response organization would be activated and would provide a response on behalf of the polluter;
- 4) The Canadian Coast Guard monitors the response as the official Federal Monitoring Officer;
- 5) The Regional Environmental Emergencies Team (REET) would provide scientific advice to the On-scene Commander on appropriate methods and procedures to best clean-up the spill;
- 6) The Canadian Coast Guard would become the On-scene Commander if the polluter was unknown, unwilling or unable to respond; and
- 7) In the event of an oil-spill, there are mechanisms that currently exist to cover the cost of clean-up activities.

4.2.6 National Aerial Surveillance Program

Internationally, aerial surveillance is widely adopted and considered to be the most effective method for the detection of oil-spills. The presence of the Canadian NASP surveillance aircraft acts as a deterrent by discouraging illegal discharges of pollution at sea. Transport Canada keeps a watchful eye over ships transiting waters under Canadian jurisdiction. Evidence gathered by the NASP crews is forwarded to the respective departmental and Environment Canada regional offices to enforce the provisions of Canadian legislation applicable to illegal discharges from ships.

The NASP features state-of-the-art Maritime Surveillance System 6000 (MSS 6000) technology. This new equipment makes Canada a world leader in detecting marine polluters. We can detect polluters at night and under low cloud, as well as isolate very fine details on the sea surface.

To supplement ongoing pollution surveillance flights, Transport Canada is also partner in the Integrated Satellite Tracking of Polluter's (I-STOP) Project, which uses earth observation technology (Radarsat imagery) to look for oil-like signatures (anomalies) on the ocean's surface that could be indicative of an oil-spill.

4.3 Environmental Effects on Spill-response in Newfoundland and Labrador

4.3.1 Introduction

One of the key factors that impacts the success of a spill-response is the weather and sea state at the time of the response. For example, oil-spill containment booms are designed and built in different sizes and strengths for different wave environments. Offshore-type containment booms are designed and built to accepted standards (e.g., ASTM- F1523) and will function effectively to hold oil when the relative velocity between the boom and the water does not exceed 0.4 m/s ($\frac{3}{4}$ knot) and the waves do not exceed about 2 metres in height. Visibility is also crucial to spill-response operations. Effective spill-response is not possible with the present state of the art in offshore oil-spill response, in conditions where the visibility is < 1 kilometre and at night. The presence of ice will also affect a spill-response operation, necessitating a change in strategies and techniques.

This section discusses the impact of the physical environment on the likely effectiveness of oil-spill response operations in the various areas offshore Newfoundland and Labrador where oil and gas operations are ongoing, or could take place.

4.3.2 Waves

Well-designed, constructed and maintained offshore-type containment booms when consistently towed by experienced vessel operators at speeds “over the water” of less than 0.4 m/s ($\frac{3}{4}$ knot) will effectively contain oil in all waves with heights up to 1 metres and in waves between 1 and 2 metres high that have periods > 6 seconds (i.e., those waves that are not too short and steep as to cause oil to be lost from the boom). In wave conditions exceeding these limits, oil cannot be effectively contained in booms for recovery by skimmers.

Wave information from the MSC50 data set (an Environment Canada hindcast database of hourly winds and waves off Eastern Canada covering the years 1954 to 2005 - Swail *et al.* 2006) was analyzed to identify the occurrence of waves suitable for offshore containment booming operations. The locations in the database selected to represent the wave climate of the different areas of offshore oil and gas activity were chosen based on proximity to the region from which visibility statistics were generated in the corresponding C-NLOPB Strategic Environmental Assessment (SEA) for the specific area. Conditions were defined to be favourable for containment when the significant wave height ($H_{\frac{1}{3}}$ - the average height of the highest third of the waves in a wave field) was less than 1 metre or when the significant wave height was between 1 and 2 metres and the period of the swell exceeded 6 s. For a selected location, the fraction of time that wave conditions were favourable for containment was calculated as the number of hours in a given month that either of the two criteria was met, divided by the total number of hours in the

given month over the 52 years covered by the data set (between 35 256 and 38 688 hours, depending on the number of days in the month). The MSC50 data set incorporates the presence of ice, setting the value of the significant wave height at “0” when the ice concentration is 50% or greater at any location. The computer algorithm used to determine wave conditions favourable for containment was written so that it did not include a 0 $H_{1/2}$ value as favourable waves, but stored it as a separate indicator of ice cover in a given area for later use.

Figure 18 shows the percentage of the time that wave conditions favourable for spill-containment operations occurred in the various areas offshore Newfoundland and Labrador. It is clear that in most areas, wave conditions favourable for spill containment will occur for more than half the time from late spring until early fall, with the best conditions for containment occurring in July for all the areas examined. In winter, the percentage of time that favourable conditions exist, ranges from 2% to 3% in the Jeanne D’Arc and Orphan Basin areas to nearly 37%, with the more sheltered areas (Sydney Basin and west Newfoundland) having, by far, the most favourable conditions for containment operations in winter.

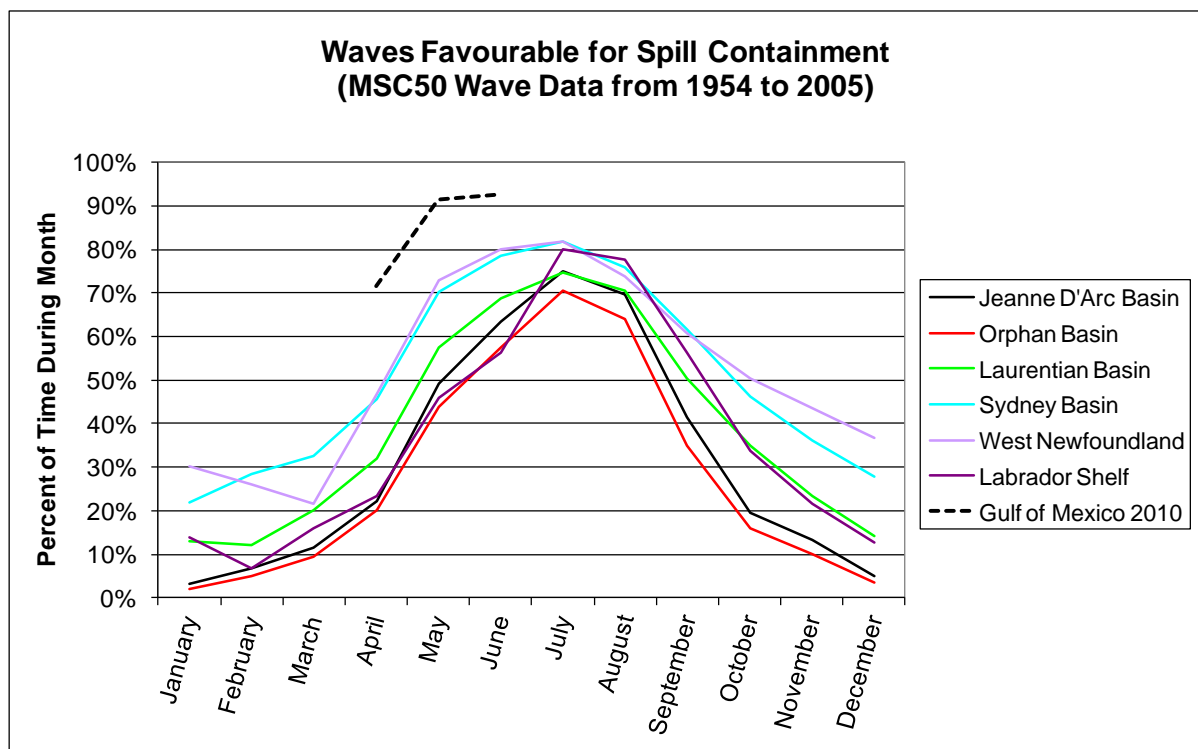


Figure 18 - Wave Conditions Offshore Newfoundland Favourable for Spill-Containment Operations

Source: (Swail et al., 2006)

For comparison, wave records from a NOAA buoy located in the Gulf of Mexico near the ongoing *Macondo* blowout spill-response operations were analyzed (from April 20 to the end of June - the last

available records at the time of writing) using the same oil-containment wave-height criteria and are plotted on Figure 18. Waves favourable for containment existed for 72% of the time at the end of April, 91% of the time in May and 92% of the time in June.

4.3.3 Visibility

In conditions where the visibility is restricted to less than 1 kilometre it is impossible to direct response operations from the air and extremely difficult to find and recover oil slicks using vessels, even with state of the art remote sensing techniques. Figure 19 shows the occurrence of these conditions in the various areas, as gleaned from visibility graphs in the various SEAs for each area. Note that, in the Labrador Shelf SEA a different criterion was used to determine visibility, a so-called “shipping criteria” of 0.5 nautical miles (0.9 kilometres), that may explain the differences in visibility statistics for that area compared with the other five areas. In most other offshore areas, the visibility is worst in summer and best in winter. The opposite seems to occur on the Labrador shelf. There is little change in the occurrence of poor visibility throughout the year in west Newfoundland waters: the monthly values range from 2 to 11%.

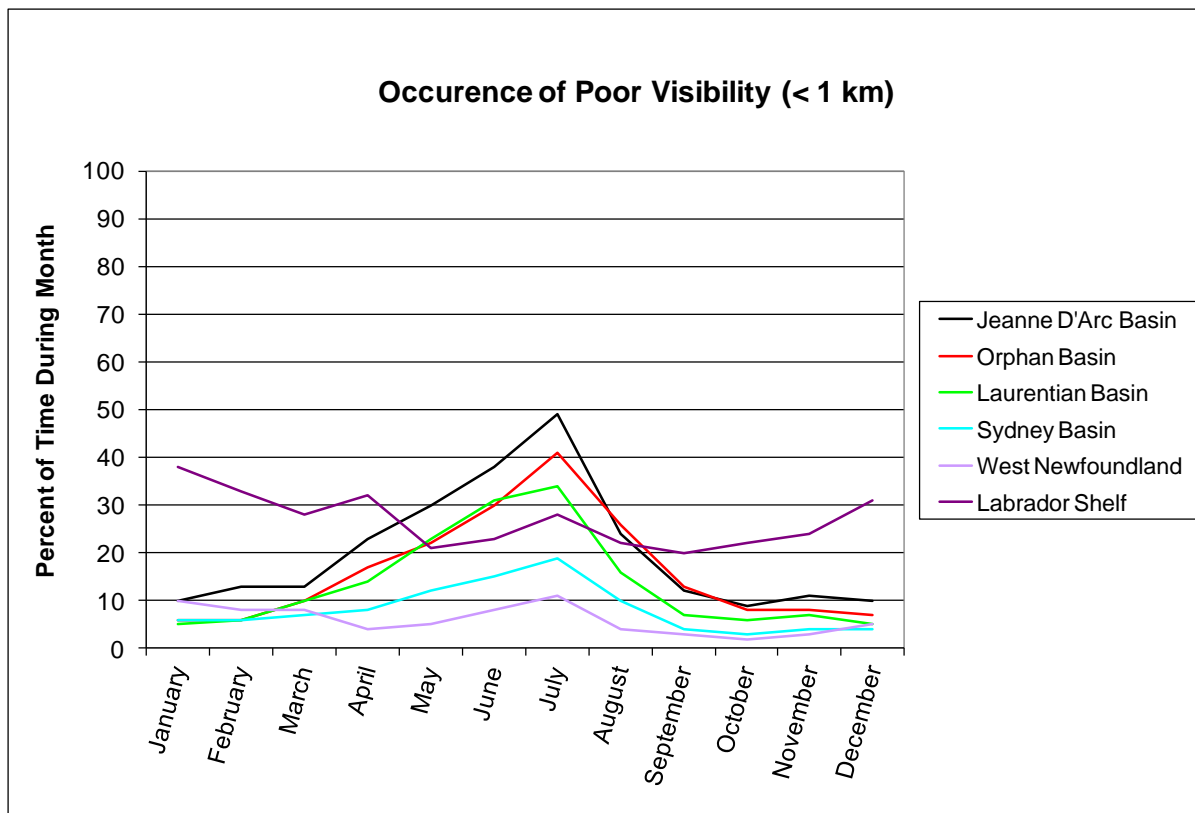


Figure 19 - Poor Visibility Conditions Offshore Newfoundland and Labrador

(Source: LGL et al., 2010)

4.3.4 Daylight

Although it may be possible to recover oil already collected and contained in a boom, spray one last oil slick with dispersants or complete an in-situ burn of oil in a fire boom at dusk, it is not possible with the state of the art to continue offshore oil cleanup operations at night. Figure 20 shows the number of daylight hours calculated for each of the offshore areas. Five of the areas lie close to the same latitude, and the hours of daylight for each vary only slightly. Daylight lasts about 9 hours in December and about 15 hours in June for these five areas. On the Labrador Shelf, daylight lasts about 7 hours in December and 17 in June.

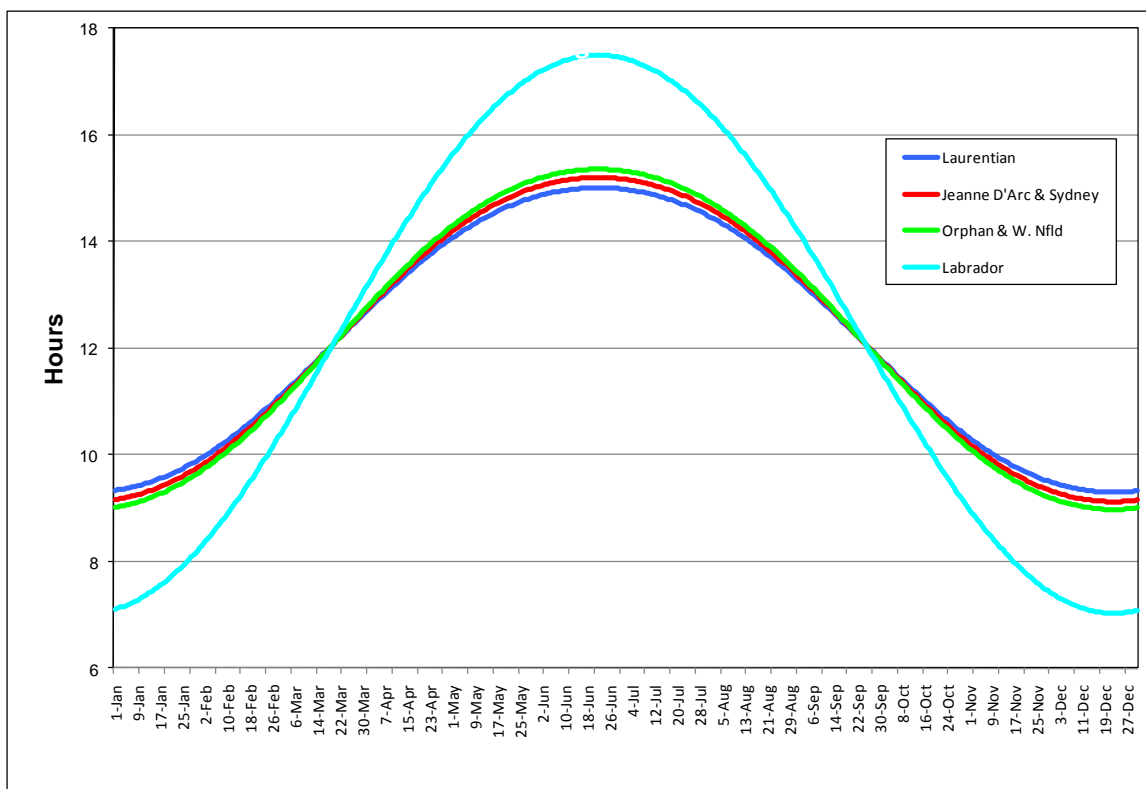


Figure 20 - Hours of Daylight at the Various Offshore Areas

(Source: LGL et al., 2010)

4.3.5 Fraction of Time Open-water Response is Possible

A method to estimate the impact of the weather and seas on the likely effectiveness of offshore countermeasures is to estimate the fraction of the time each month that offshore countermeasures would be possible, considering the time that the waves are favourable, the visibility is acceptable, and the amount of daylight available. The variable calculated by this approach is called F_{TRP} , or the fraction of time response is possible. Of course, spill size, response time, specific response equipment capabilities, responder training, and many other variables come into play in determining the actual effectiveness of the

response to a real spill. The F_{TRP} approach allows a comparison among different regions and times of the year of what a state of the art response with unlimited resources could achieve with a given spill scenario.

Figure 21 compares the calculated F_{TRP} for open-water mechanical response (i.e., using offshore containment booms) for the various Newfoundland and Labrador offshore areas over the year. In the Jeanne D'Arc and Orphan Basin areas, the calculated F_{TRP} ranges from 0.01 to 0.03 in winter (i.e., mechanical response could be effective only 1 to 3% of the time) to 0.26 to 0.30 in summer. In the Laurentian Basin area the situation is similar, having F_{TRP} values of about 0.04 in winter and 0.30 to 0.35 in summer. In the slightly more protected waters of the Sydney Basin area, the winter values of F_{TRP} range from 0.07 to 0.11 and summer values range from 0.40 to 0.45.

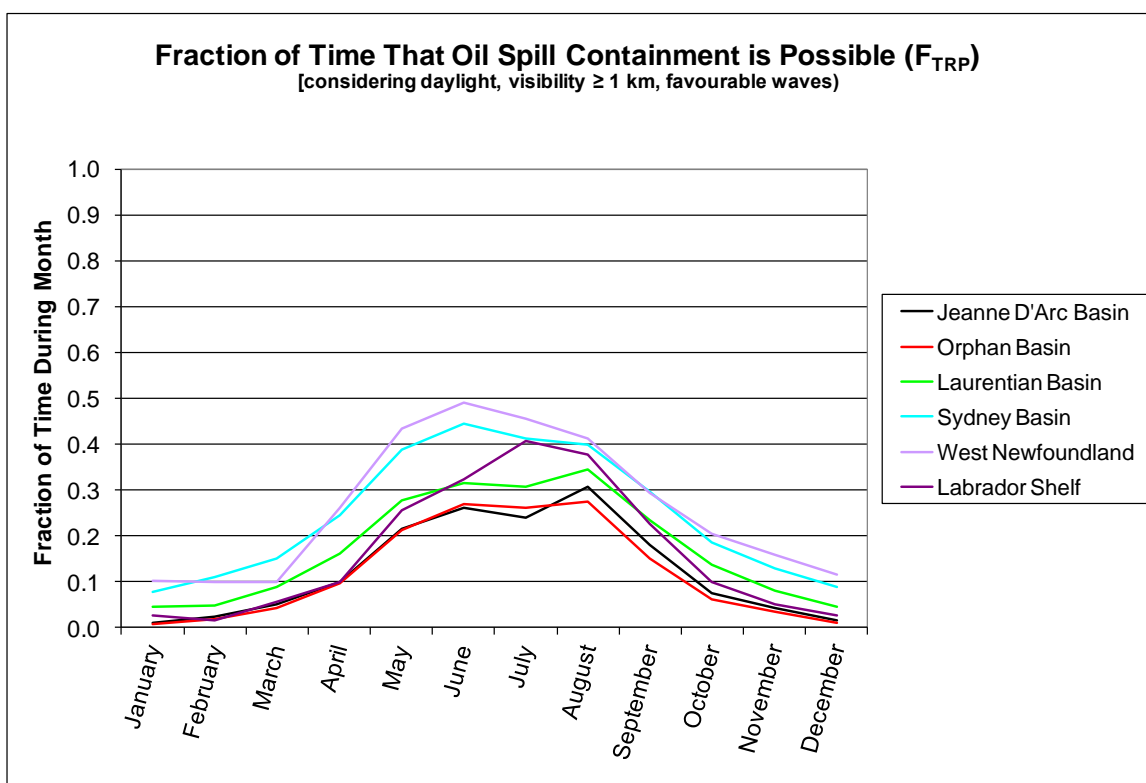


Figure 21 - Fraction of Time During the Year that Mechanical Response is Possible

Source: Calculated from data in (Swail et al. 2006) and (LGL et al. 2010)

The waters off west Newfoundland are the best suited for mechanical response operations, having calculated values of F_{TRP} of 0.10 to 0.12 in winter and 0.41 to 0.49 in summer. The values for the Labrador Shelf range from 0.02 to 0.03 in the winter months and 0.32 to 0.41 in summer.

4.3.6 Ice

Both the waters of the Labrador Shelf and west Newfoundland can experience considerable amounts of ice during the winter months. Although the presence of ice precludes efficient mechanical recovery techniques, spilled oil can still be removed effectively from ice-covered waters using other techniques, such as in-situ burning, oil-mineral aggregate (OMA) application, and dispersant application, the latter two techniques followed by mixing with propeller wash using ice-strengthened vessels.

Figure 22 presents the occurrence of ice (50% or greater coverage) at each of the areas. There is a high probability that ice will be present in the Labrador Shelf and west Newfoundland areas in winter. For the Sydney Basin, the fraction of time ice is present peaks at about 0.25 in March and for the Laurentian Basin it is greatest at 0.12 in February. In the Jeanne D'Arc Basin area the greatest fraction of time ice is present is 0.05 and in the Orphan Basin area about 0.02.

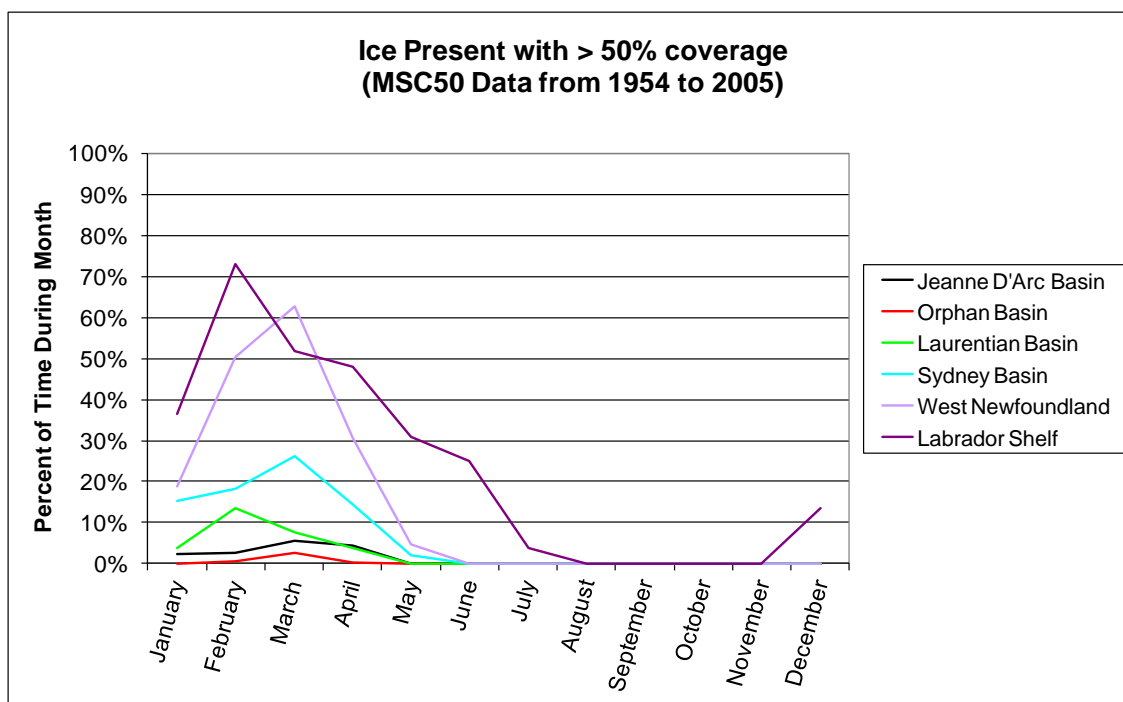


Figure 22 - Occurrence of Ice Cover in the Offshore Areas

(Source: LGL et al., 2010)

4.3.7 Dispersants

The application of chemical dispersants to cause surface oil slicks to mix into the water column as small droplets that diffuse to low concentrations and are eventually biodegraded is an important offshore oil-spill response tool. Dispersant application, either by vessel or aircraft, is not constrained by waves to the extent that mechanical recovery is, although dispersant operations are restricted by visibility and darkness

to the same extent as mechanical response operations. Considering all the available dispersant application platforms (vessels, helicopters and fixed-wing aircraft) an upper limit for dispersant application has been set at winds exceeding 35 knots (17 m/s). Using this criterion, the MSC50 database was accessed to estimate the percentage of time in each month that winds exceeded 17 m/s. Coincidentally, the percentage of time that winds exceed 17 m/s in a given month is one of the variables that can be displayed on a map of the MSC50 area in the web-based version of the data set, and this map was used to estimate the statistic in the six areas of interest here. The visibility data and daylight hours were combined with the wind speed exceedance data to produce a fraction of time that dispersant application is possible (F_{TDP}).

Figure 23 presents the calculated monthly values of F_{TDP} for the six offshore areas of interest. Not surprisingly, given the different criteria, the F_{TDP} values are higher than the corresponding F_{TRP} values. The major difference occurs in the winter months in all areas: the F_{TDP} values in the winter months are more than an order of magnitude greater than the corresponding F_{TRP} values in the most exposed offshore areas (Jeanne D'Arc and Orphan Basins) and at least three times greater in the other areas. It should be noted that the “Window of Opportunity” for using dispersants on a particular oil slick will close when the viscosity of the oil exceeds about 20 000 mPas, either by weathering, the onset of gelling of the oil, or the formation of stable water-in-oil emulsions. Dispersant application is well suited to blowout spill-response since fresh oil is being released continuously.

Environmental Aspects of Dispersants

Dispersants are materials that are applied to oil slicks during spills to facilitate dispersal of the slicks. In the late 1980s, dispersant use policies in North America were restrictive due to concerns about the environmental risks from the dispersed oil. Methods for assessing the potential net environmental benefit (NEB) of dispersants for local spills were developed in the 1980s. This helped Government regulators to develop environmentally rational dispersant policies and led to the establishment of pre-approval zones in most U.S. waters by 2005. However, in the late 1980s, when these NEB tools were first developed, the impact assessment models used in them had not been ground-truthed. Following the *Sea Empress* spill, in which dispersants were used extensively, U.K. scientists credited dispersants with helping to minimize environmental damage from the spill. This effectively proved the NEB approach. From the late 1990s to 2005, numerous US Coast Guard-sponsored NEB workshops were held in the US to consider the environmental aspects of dispersants in local spills in all marine areas of the U.S. These led to establishing of dispersant pre-approval zones in all coastal jurisdictions in the US. Over the same period, a series of projects assessed NEB and operational feasibility for using dispersants to treat spills from offshore production operations in the Gulf of Mexico, Southern California and Grand Banks of Newfoundland.

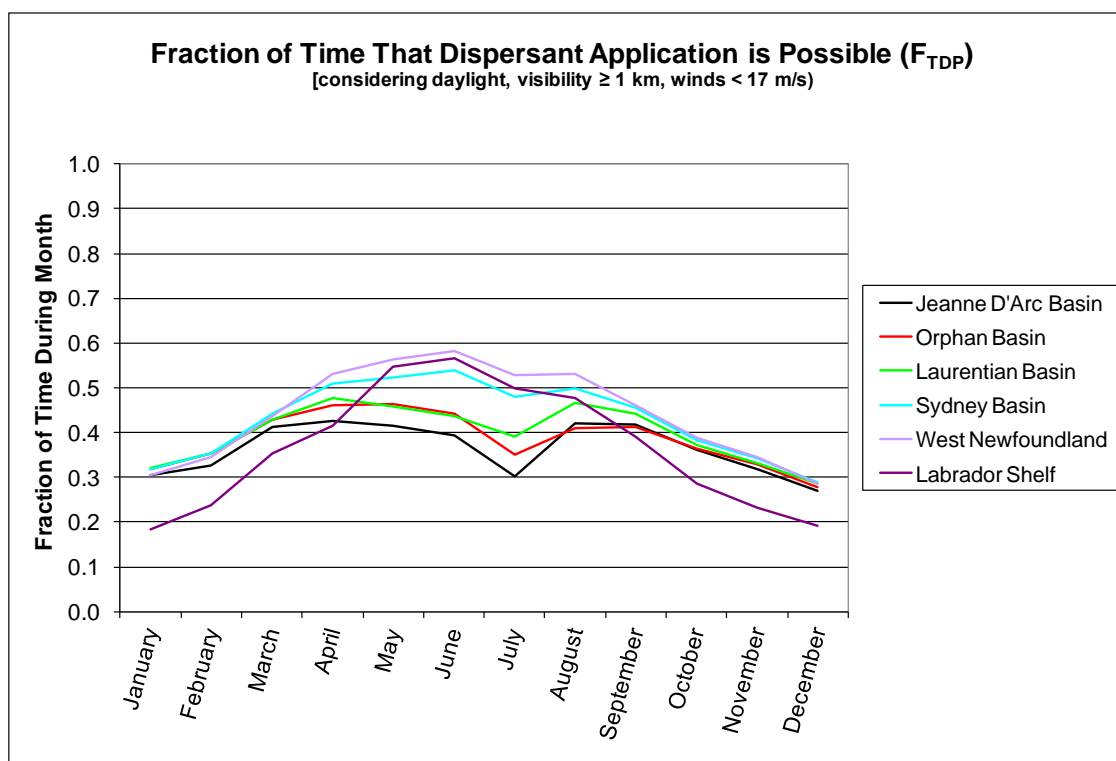


Figure 23 - Fraction of Time During the Year that Dispersant Application is Possible

Source: Calculated from data in (Swail et al. 2006) and (LGL et al. 2010)

An important step in establishing pre-approval for dispersant use in the US was the development of a formal process for monitoring dispersant operations to assess: a) effectiveness of dispersant applications and b) dispersed oil concentrations generated in the water column (to which VECs were exposed). The US Coast Guard and NOAA developed a dispersant effectiveness monitoring protocol, “Special Monitoring of Applied Response Technologies (SMART)” (Barnea and Laferriere, 1999). After 15 years of use, the SMART dispersant protocol was critically evaluated and recommendations were made for improvement. SMART monitoring was important part of the dispersant response during the BP MC252 spill (U.S. Louisiana, 2010).

4.3.8 In-Situ Burning

The use of in-situ burning (ISB) in fire booms during the Macondo blowout response resulted in the removal of more than 41 000 m³ of oil without the need for skimming, temporary storage, transfer and disposal of recovered oil. This incident will likely mark the “coming out” for ISB as a response option for offshore blowout spills in open-water (ISB is particularly suited to blowout spill-response because there is a constant supply of fresh oil - once slick emulsion water contents reach about 25% to 50%, ignition is extremely difficult).

The F_{TRP} analysis is not strictly applicable to the use of fire booms to collect and burn oil. This is because, at present, there are no offshore-rated fire booms available that can operate in sea states as high as conventional offshore containment booms (although with their demonstrated success in the Gulf of Mexico, this situation is likely to change). Existing fire boom systems, primarily because of the weight of their fire-resistant components, fall into the “protected waters” category with applicability to somewhat lower wave heights than the larger, offshore-rated conventional containment booms.

It is not likely that ISB in fire booms would offer much additional effectiveness to spill-response in winter conditions in any of the offshore areas under consideration, but it could offer a significantly increased oil-removal capacity in summer months, particularly in the less exposed areas of west Newfoundland, Sydney Basin and the Labrador Shelf.

ISB will also be applicable to spills in ice conditions in Newfoundland and Labrador waters. It could be used to remove oil:

- Spilled under sea-ice, which then migrates to the surface during the spring and collects in melt pools;
- On water between ice floes that has been herded to burnable thicknesses by either wind or chemical herding agents; and,
- In fire booms maneuvered in light ice conditions to collect oil and ice pieces.

Environmental Aspects of In-Situ Burning

In the early 1990s, in-situ burning technology was proven, but there were two environmental concerns about its use. These concerns included: a) risks to humans from the smoke and b) environmental risks from the burn residue, which floats and may escape containment after a burn. The question of risk to humans from smoke was addressed when US Government agencies developed the in-situ burning component of the SMART monitoring protocol. Until the early 1990s, environmental concerns about burn residue were addressed by proposing to collect any floating residue from burns with nets. However, during the Haven spill the spilled oil burned, producing large amounts of residue that sank to the seabed due to the relatively unique properties of the spilled oil. The sunken residue effectively closed local fisheries for two years. Subsequent research into the properties of burn residue has identified the types of oil that can sink after burning and has shown that burn residue is relatively non-toxic.

4.4 Tanker-spill Response Considerations

4.4.1 Government Responsibilities

In June 1989, following the *Exxon-Valdez* spill, the Canadian Government appointed the Public Review Panel on Tanker Safety and Marine-spills Response Capability (the Brander-Smith Panel). The Panel submitted its final report in October 1990, to which the Government made a preliminary response in November of that year. Subsequent to and based on the Panel's recommendations, consultations were initiated by the CCG and Environment Canada with private industry stakeholders with the objective of developing a new regime based on a private-sector funded response capability. The *Canada Shipping Act* was subsequently amended to incorporate these improvements and remains the governing legislation concerning Canada's vessel-related spill-response capability.

The end result of these consultations was Canada's Marine Oil-spill Preparedness and Response Regime. Transport Canada is the lead federal regulatory agency responsible for the regime, which was established in 1995 and is built on a partnership between Government and industry. Within the framework of the regime, Transport Canada sets the guidelines and regulatory structure for the preparedness and response to marine oil-spills.

The Regime is built on the following principles:

- Designated areas of primary risk: Areas having higher traffic volumes have a greater likelihood of spill incidents and require resources to initiate an immediate response.
- Tiered response structure: Small spills require resources dedicated to the designated areas of primary risk, whereas larger spills may utilize response resources from other regions as needed.
- Equipment and time standards: Equipment to deal with four levels of response (Table 9) are established based on agreed-upon capacities for booms and skimmers.
- Response strategy: Equipment stockpiles contain a mix of equipment to provide a response based on containment and recovery of oil in offshore and nearshore marine environments, nearshore protection, and shoreline equipment. In-situ burning and dispersant-use are not considered.

Table 9 - Tiered Response Capability Standards

Tier	Rated response capability	Response Time
1	150 tonnes	6 hours
2	1 000 tonnes	12 hours
3	2 500 tonnes	18 hours
4	10 000 tonnes	72 hours

4.4.1.1 Transport Canada

As the lead regulatory agency for the Regime, Transport Canada is responsible for its governance. Specific activities include:

- Regime management and oversight.
- Development of regulations and standards.
- Enforcement and implementation of regulations relating to response organizations.
- Enforcement and implementation of regulations relating to oil-handling facilities.
- Overseeing an appropriate level of national preparedness.
- Monitoring marine activity levels, conducting risk assessments and making adjustments to the Regime, as required.
- Monitoring and prevention of marine oil-spills through the implementation of the National Aerial Surveillance Program.
- Implementation and facilitation of the Regional Advisory Councils.
- Providing leadership for the International Maritime Organization Oil-Pollution Preparedness, Response and Cooperation / Hazardous Noxious Substances Technical Group as Canadian head of delegation.
- Providing leadership for the Arctic Council - Emergency, Prevention, Preparedness and Response Working Group by ensuring representation of Canadian Arctic interests at the international level as Canadian head of delegation.
- Providing post-mortem reporting for oil-spill response exercises and incidents, both nationally and internationally, to ensure that the recommendations and/or lessons learned are considered and implemented as appropriate to enhance the Regime.

4.4.1.2 Fisheries and Oceans Canada / Canadian Coast Guard

The CCG is responsible for conducting spill management under Section 678 of the *Canada Shipping Act*. Specifically, it:

- Provides a national preparedness capacity and manages the National Response Team;
- Ensures an appropriate response to marine pollution incidents as the Federal Monitoring Officer or On-scene Commander.

4.4.1.3 Other Federal and Provincial Agencies

Other agencies may supply an advisory role to the response effort through the Regional Environmental Emergencies Team (REET). The REET has a mandate to advise the On-scene Commander (OSC) of an incident on environmental priorities and on scientific and other regional concerns related to the incident. If the polluter is acting as the OSC, advice would be provided through the CCG through its role as the Federal Monitoring Officer.

4.4.2 Industry Responsibility

Ships that transit Canadian waters are required to have a shipboard oil-pollution emergency plan, as well as an arrangement with a certified Response Organization (RO) that would respond to a spill on the polluter's behalf. In addition, oil-handling facilities or anyone who loads and unloads oil and oil products are required to have an oil-pollution emergency plan, as well as response equipment on site during the transfer.

Response organizations are certified every three years by Transport Canada. Certification is based on compliance with the equipment standards required to respond to the four Tiers of response noted above, as well as other specified training and exercising requirements. Oil-handling facilities and ships pay an annual fee to response organizations to maintain the level of preparedness to respond to a spill in the event that they have one. In the case of ships, the fees are based on the volume of oil that is transported.

There are four certified response agencies:

- Atlantic Emergency Response Team (ALERT)
- Eastern Canada Response Corporation Ltd. (ECRC)
- Western Canada Marine Response Corporation (WCMRC, aka Burrard Clean)
- Point Tupper Marine Services Ltd. (PTMS)

Of particular relevance to Newfoundland and Labrador, ECRC has a significant equipment depot in Mount Pearl (St. John's) and Dartmouth, Nova Scotia. Additional resources, in the event of a Tier 3 or Tier 4 incident, can be brought in from other ECRC depots in the Quebec Region (Québec, Sept-Îles, and Verchères) and the Great Lakes Region (Corunna).

4.4.3 Issues Specific to Newfoundland and Labrador

In 2005, Transport Canada commissioned a study on the current and future risks of oil-spills in Newfoundland waters related to marine traffic. The resulting study, "Quantitative Assessment of Oil-spill

Risk for the South Coast of Newfoundland and Labrador”, was published in March 2007, and in synopsis form later in 2007.

The area of interest for the study was the entire south coast of Newfoundland, from Cape St. Francis (east near St. John's) to Cape Ray (west near Port aux Basques), including Placentia Bay to the 50 mile limit. The approach of the study included assessing both of the key components of risk: the probability of an oil-spill occurring and the consequences of the spill should it occur.

The risk study included the following key elements:

- Stakeholder Consultation: relevant organizations and the general public were consulted for their concerns on spill risks in the region.
- Oil-spill Frequency: the likelihood of oil-spills within the area was estimated based on historical spill rates and the level of marine traffic within the area.
- Environmental Impact Assessment: the potential effect of oil-spills was estimated for key species.
- Economic Impact Assessment: the potential economic consequences of various spill scenarios were estimated.
- Risk Results and Conclusion: the elements of probability and consequence were combined to produce an estimate of the overall risk in the region.
- Area Specific Factors and Future Trends: potential changes in marine activity over the next 10 years were estimated to assess the likelihood of changes in the spill-frequency estimations.

The consultation process was held over the period of June to September 2006, and included: Transport Canada, Fisheries and Oceans Canada / Canadian Coast Guard, Government of Newfoundland and Labrador Department of Environment and Conservation, Environment Canada, and the Regional Advisory Council (RAC), and was open to citizens and organizations in local communities that could be financially harmed by a spill.

One of the key findings of the risk assessment project indicates that the most probable area for a spill is in inner Placentia Bay. Compared with previous national studies and analysis, the risk has decreased over the years, primarily due to increased preventive measures that have been implemented, including the phase-in of double-hulled tankers, the requirement to have contracts with response organizations, and increased monitoring and inspections. The findings also note that while Placentia Bay may be among the busiest ports in Canadian terms, the vessel traffic density is low relative to other areas of the world.

In September 2007, the synopsis version of the report was circulated among the above stakeholders and comments solicited on the conclusions and on possible changes to the prevention and response regime. As a result, local and regional interests in the area made some 25 proposals. The following table summarizes each proposal and the resulting action item for, in most cases, either Transport Canada (TC) or Canadian Coast Guard (CCG). The proposals are grouped into four broad categories of: Prevention, Response, Research, and General.

Table 10 - Summary of Proposals

Prevention	
1. Line of Control Tankers entering Placentia Bay are presently permitted to travel no farther north than 47°N unless arrangements have been made for pilotage. It is now proposed to move the line of control farther south, to approximately 46.5°N, essentially a line across the mouth of Placentia Bay.	TC will move the line of control to the mouth of Placentia Bay; TC to discuss with PB Traffic committee first
2. Vessel Traffic Station in Argentina A vessel traffic station (VTS) should be established in Argentina for monitoring and emergency response.	VTS is currently in Argentina; Discussion of locating an equipment depot in Argentina is contained in Item #11.
3. Vessel Location Instrumentation All vessels should be equipped with at least minimal technical instruments for location and communication.	TC/CCG: continue to broadcast from VTS to announce tanker movements. TC/CCG to include in public information document: description of traffic lane system, importance of fishing vessels being equipped with radio gear, and specification of radio channels that are used for announcements and warnings.
4. Use of Double Hulls All tank-vessels transiting Placentia Bay should be double-hull rather than single-hull.	TC will perform regular inspections to ensure compliance with the regulated phase-in of double-hull tankers.
5. Aerial Surveillance Program (NASP) Transport Canada's aerial surveillance of vessels and oil-handling facilities is commended, and should be continued and increased.	TC will continue to support and refine the NASP.
6. Enforcement of Controls Established controls within Placentia Bay should be stringently enforced.	TC Regional staff has addressed this concern directly with the company in question, and they have agreed to respect the traffic scheme. TC will continue to monitor the situation.
7. Additional Radar Monitoring Radar monitoring capabilities should be established from Burin west.	TC and CCG will revisit the issue if warranted by an increase in traffic.
8. Pilotage for Long Harbour Introduce pilotage for the part of the bay extending to Long Harbour.	Pilotage regulation has been amended: vessels calling at the proposed nickel-receiving terminal at Long Harbour, will have pilots on board.

9. Escort and Rescue Tugs An ocean-going escort and rescue tug (with at least 10 000 horse power) should be available year round to respond in the event of a tanker incident inside Placentia Bay or within 30 to 40 miles of the approach to the Bay.	TC will continue to monitor the situation and revisit the issue if needed.
Response	
10. Designation of Places of Refuge Designated places of refuge for tankers in distress must be established.	TC (with CCG involvement): commit to including in exercises, consult with PB traffic committee for advice on specific sites.
11. Location of Response Equipment Response capabilities for any such emergency be moved into Placentia Bay at a central location closer to risk than the current deployment ability in St. John's.	Coincident with the home-porting of the CCGS Louis St. Laurent to Argentia, the CCG is considering positioning response equipment to this location. Similar caches of response equipment are currently located at other sites in the region where the CCG maintains a facility.
12. Additional Response Capability An additional 2500 tonnes of rapid-deployment response equipment should be added in strategic locations in Placentia Bay. These locations should be determined through further study of sensitive areas and likely spill-trajectory scenarios.	TC is satisfied that the current RO equipment capabilities and response time standards are being met.
13. Response Time Standards The response time standards set by Transport Canada should be cut in half for all spill categories. To illustrate, for a Tier 4 spill in the Geographic Area of Response (GAR), the response time standard should be 41 hours as opposed to the current 82 hour standard. The Regional Advisory Council (RAC) recommends Transport Canada review and consider response standards similar to those imposed by Norwegian responsible authorities.	TC is satisfied that the current RO equipment capabilities and response time standards are being met.
14. Designation of Waste-Handling Sites There is an immediate requirement for provincial responsible authorities to designate areas and capacity for handling collected oil and oiled debris from a major spill.	TC to confirm that NL provincial authority is moving forward on this
15. Bird Rescue and Rehabilitation Local bird rescue and rehabilitation capacity must be increased and this local capacity must be used first in oil-pollution cases. Placentia Bay is a safe haven for many species of seabirds and effective local response capacity will be a necessity in the event of a spill.	TC/CCG to confirm capability exists in local and national plans of Government and industry; The Canadian Wildlife Service will take the lead in providing advice on bird rehabilitation and other wildlife issues.
16. Testing of Equipment Cascading The capability of ECRC to cascade equipment should be tested under conditions as realistic as is possible. This should include the capability to obtain the required amount of equipment from other Provinces in all weather and in all Gulf of St. Lawrence ice conditions within the stated time limits, and should be confirmed in an unplanned test.	TC to continue regular audits of RO capabilities, including unscheduled exercises if deemed necessary.

17. Training of Fishermen for First Response Provide funding for community-based training of local fishermen.	CCG continues to provide guidance to local authorities on spill issues and concerns, but does not support a volunteer work force in a spill-response for reasons of safety and liability.
18. First Responder Equipment Financial incentives should be available to encourage fishers and aquaculture farmers to acquire first responder kits.	CCG continues to provide guidance to local authorities on spill issues and concerns. CCG will not provide financial support for first responder kits.
Research	
19. Research on Ecosystem Effects Additional research is required to assess potential effects on south coast NL ecosystems, specifically: Regular, systematic, long-term observation at the breeding and wintering sites of bird and animal species (e.g., areas such as Cape St. Mary's and Lawn Islands) Continued beached bird surveys and long-term tracking studies along the Cape Shore and elsewhere in the primary risk areas Independent research on species where data is currently lacking (the assessment indicates there is insufficient knowledge on, for example, caplin, lobster, otters, turtles and various bird species). Assessment of cumulative effects in the region and the region's limits to capacity.	CWS (EC) will continue to conduct surveys of potentially affected species and habitats; will continue to assist industry and local interests in their surveys
20. Research on Response Priorities Research is required on how response efforts should be prioritized in Placentia Bay. This would allow responders to target key areas first in the case of a spill, such as fragile ecosystems and aquaculture sites. This research will also support decisions made with respect to the placement of rapid response equipment.	EC will continue to maintain and update the sensitivity databases as appropriate. CCG, TC, and ECRC will continue to use the system in training, exercises, and responses.
21. Representative Oil-spill Scenarios The accuracy of trajectory modeling should be quantified for spills in the region.	TC/CCG: continue to use EC expertise in future training, exercises, and responses
22. Emergency Management Plan An emergency management plan for Placentia Bay be developed and include prevention, preparedness, response, mitigation, and recovery.	TC/CCG: provide concise document on "who does what?" ; to include contact information for public use.
General	
23. Independent Oversight Committee An Independent Oversight Committee should be established and provided with the fiscal and technical resources to monitor and implement the preceding plan.	TC/CCG: continue to participate in the Placentia Bay Traffic Committee, and will consult with the Committee on issues identified in this report.
24. Consultations with Pilots Consultations should be undertaken with pilots of vessels operating in and around Placentia Bay with regards to spill risks, the most effective prevention and response methods, and use of tugs for rescue and escort.	TC/CCG: continue to consult with the Atlantic Pilotage Authority (APA) as required.

<p>25. Occurrence of Mystery Spills and Bilge Dumps</p> <p>Documentation is needed on the number of mystery and bilge-dumping incidents versus other oil-related incidents in order to measure the effectiveness of the NASP.</p>	<p>TC: continue NASP program, prosecutions, and collection of spill statistics to ensure current downward trends continue.</p>
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4.4.4 Summary of Tanker-spill Considerations

Subsequent to the *Exxon Valdez* oil-spill in 1989, and the recommendations of the Brander-Smith Panel that followed, the Canadian Coast Guard and Environment Canada overhauled the regime for tanker-spill-response. One component of that was a process to re-visit the issue of spill risks, resulting in the report commissioned by Transport Canada entitled, “Quantitative Assessment of Oil-spill Risk for the South Coast of Newfoundland and Labrador”, published in 2007. The study included a consultative process with local stakeholders, and resulted in the submission of some 25 proposals. All proposals were given a serious review, and a plan of action for implementing a number of the worthy concepts has been recently approved.

4.5 Comparison of Comparable Jurisdictions

4.5.1 Introduction

The purpose of this section is to provide a general overview of the various components of oil-spill response preparedness, training and commitment of Canada and comparable jurisdictions. Australia, Norway, the U.K. and the U.S. were chosen as they were thought to have levels of environmental commitment and general industrial practices comparable to those in Newfoundland and Labrador and Canada. This section is not intended to be a critique of comparable jurisdictions, but a method of determining if Newfoundland and Labrador is adequately prepared for an effective major oil-spill response.

The introduction highlights some general preparedness and response good practices that are common in much of the developed world. Similarly, the International Marine Organization's training guidelines and several international conventions and agreements are also briefly discussed.

4.5.1.1 Preparedness and Response Good Practices

The International Petroleum Industry Environment Conservation Association (IPIECA) has produced a summary of their Oil-spill Preparedness and Response Report Series (Report Series Summary) (IPIECA, 2008). The individual reports within the summary *“represent a consensus of industry views on good practice in oil-spill preparedness and response. They are made available to guide oil-spill response managers, practitioners, trainers and Government officials alike.”* The Report Series Summary states that there are two good practices that apply to every contingency plan and response and, while there are many other specific good practices, this section summarizes only the two.

The first good practice is to base any response on a Net Environmental Benefit Analysis, which means to weigh the environmental consequences of one action against another or against the consequences of doing nothing. At times, intensive cleanup efforts can cause more damage than letting nature take its course, showing that a more hands-off approach such as surveillance and monitoring, might be more suitable.

The other widely accepted good practice is the Tiered Response approach. The Response Series Summary includes a *Guide to Tiered Preparedness and Response*, which outlines a scheme that classifies spills according to their size and proximity to response resources. IPIECA recommends that a separate contingency plan should cover each Tier and should be directly related to a company's potential spill scenarios.

- *“Tier 1: operational-type spills that may occur at or near a company’s own facilities as a consequence of its own activities. An individual company would typically provide resources to respond at this Tier.*
- *Tier 2: a larger spill in the vicinity of a company’s facilities where resources from other companies, industries and possibly Government agencies can be called in on a mutual aid basis.*
- *Tier 3: larger spills where substantial further resources will be required and support from national or international cooperative stockpile may be necessary.”*

4.5.1.2 IMO Model Training Courses

The International Maritime Organization (IMO) has three model training courses that were developed by an international field of experts in order to provide guidance for developing oil-spill preparedness, response and cooperation, as per OPRC 1990:

- IMO 1 is a first responder’s course designed for those who will be responsible for site cleanup operations, both at sea and on the shore. It provides the necessary information and skills required to effectively use response equipment and lead a team of response workers.
- IMO 2 is a course designed for On-scene Commanders. It provides the knowledge and skills required for an Incident Commander to effectively manage a response, including coordination with other agencies, various cleanup techniques and cost recovery requirements.
- IMO 3 is designed for senior managers and administrators who are responsible for the overall management of an oil-spill. It includes training for the control of crisis situations, political, media and public interaction as well as legal and financial implications (Training OSS).

Not all oil-spill response courses offered by various agencies correspond to one of the three IMO model courses. Courses offered in the United States, for example, are designed to comply with their own regulations.

4.5.1.3 Data Sources

Most of the information in this section is country specific and is referenced accordingly at the end of this report. Due to the regional specifics of the data there will be some inconsistencies with the amount and type of data available and presented in this section; however this should not affect accomplishing the overall purpose of this section.

The International Tanker Owners Pollution Federation Limited (ITOPF) provides country profiles intended to inform tanker operators of the response capabilities and practices of various countries (ITOPF

Country Profiles). Much of the information in these country guides is taken directly from country-specific resources and the respective Government agencies responsible for oil-spill response and while the information is not comprehensive, it provides an effective base for comparison. Information used from these country guides was confirmed, updated and expanded when possible. Some information from media sources has also been included.

4.5.2 Norway

Norway, like the other countries examined, manages a range of oil-spill contingency plans having equipment and personnel in various locations around the coast. Its national response strategy is the primary responsibility of the Norwegian Coastal Administration, a Governmental agency, and the Norwegian Clean Seas Association for Operating Companies, an industry agency. Norway has experience dealing with various oil-spills and is party to many international conventions and agreements.

Information presented about Norway's preparedness, training and commitment is based largely on (Bjerkemo, 2010), (Brekne et al, 2005), (ITOPF Norway, 2008) and (Norwegian Coastal Administration), among other sources.

4.5.2.1 National Oil-spill response Strategy and Policy

As per the *Norwegian Pollution Control Act*, the National Oil-spill Contingency System (NOSCS) delegates specific responsibilities to federal and municipal Governments along with private industry. All response plans and agencies are standardized and coordinated through the NOSCS. In the event of a major oil-spill, the NOSCS would operate as a single integrated response organization (Norwegian Coastal Administration).

The Norwegian Coastal Administration (NCA) is in charge of the NOSCS and, as such, is responsible for coordinating the municipal and federal Government's oil-spill response preparedness as well as private industry preparedness. It is lead by a Director General who reports to the Norwegian Minister of Fisheries. The NCA is also responsible for monitoring incidents and, if necessary, they can assist or take control if the responsible party is in a situation beyond their capability or are performing unsatisfactorily. The spills for which they are responsible include those from ships, major spills from unidentified sources and any other spills not handled by private or municipal preparedness agencies. They coordinate all levels of response agencies in case of a major oil-spill and there are agreements with other Governmental and private agencies regarding assistance with personnel and equipment (Norwegian Coastal Administration).

Whereas the NCA is responsible for oil-spill response from ships, the respective operators are responsible for spills from offshore installations. On behalf of and in cooperation with operators, the Norwegian Clean Seas Association for Operating Companies (NOFO) implements and coordinates all industry oil-

spill responses. NOFO, a cooperation of all 16 companies operating on the Norwegian Shelf, states its main objectives are to establish and maintain oil-spill emergency preparedness and to coordinate and communicate relevant oil-spill contingency issues between members and regulating authorities. On behalf of the operators, NOFO has completed the development of a risk based oil-spill contingency regime for the Norwegian continental shelf (Brekne et al, 2005).

The Norwegian Government requires that industry locations having potential for oil-spills (including operators on the Norwegian Continental Shelf, crude oil terminals, refineries, distributors, etc) have an adequate level of preparedness (Norwegian Coastal Administration). Around 70 land-based oil-handling companies are subject to separate preparedness requirements and contingency plans.

Thirty-four inter-municipal preparedness areas, consisting of a total of 430 municipalities, each have their own specific contingency plans. Local authorities, which consist of a collaboration of local agencies (e.g., fire department, port authority, etc.), are responsible for minor spills if they are not covered by the polluter's private contingency arrangements (Norwegian Coastal Administration).

The contingency system is highly developed having response equipment distributed throughout the country. Whereas the NCA provides equipment, material, vessels and personnel (including expert advisors), the Government may call upon industry in the event of a major oil-spill and equipment can be used from industry/NOFO stockpiles. Resource owners are compensated for use of their equipment (Brekne et al 2005).

The NCA has copies of intercommunity contingency plans, which have info on local coastal sensitivities. They also have the Marine Resource Database, with coastline sensitivity maps and are responsible for notifying any organization potentially at risk from a spill (e.g., a means to inform fish farmers).

The NCA controls the National Training Centre for Oil-Pollution Control and the National Test Centre for Oil-spill Response Technology (ITOPF Norway, 2008).

According to (Bjerkemo, 2010) *“The responsibility of the private industry and the municipalities is well understood and all the different organizations have contingency plans in place.”*

Response Policy

The primary objective of a spill-response in Norway is to contain and recover the oil as close to the source as possible. Dispersants are considered to be supplementary to physical removal and the Norwegian Pollution Control Authority must approve their use if they are not already part of a pre-approved contingency plan. The application for use of a particular dispersant is based on a Net Environmental Benefit Analysis (ITOPF Norway, 2008).

Complementary to the above, the Norwegian oil-spill response philosophy has subsequent spill barriers and strategies (Breken et al, 2005):

- Barrier 1 - Heavy oil-spill combat systems near the source of offshore pollution
- Barrier 2 - Medium to heavy oil-spill combat systems targeting oil that has passed barrier 1
- Barrier 3 - Medium to small oil-spill combat systems targeting oil in the coastal zone
- Barrier 4 - Small oil-spill combat systems targeting oil near the shoreline
- Barrier 5 - Shoreline cleanup and restoration
- Monitoring and surveillance

4.5.2.2 Guidelines and Regulations for Offshore Operators

Offshore petroleum operators are required by the Government to prepare, and submit for approval, contingency plans detailing the organization, command structure, communications, cleanup operations and termination procedures applicable during an incident. Response capability standards are developed on a site-specific basis and vary with such factors as oil production rates of a particular field, sensitivity of the local environment, distance to sensitive areas, and distance to additional response resources. Typically, this results in a target of 3 000 m³/day (approximately 2 500 tonnes) recovery capacity, although the figure could be higher or lower depending on the variables noted above. For example, for a recent exploration program in the Barents Sea, a fairly rigorous standard was established due to the perceived sensitivities of this region. The operator was required to make arrangements to have one containment and recovery system on-site within 2 hours, which essentially mandated a standby system on site. Further, a second system was to be available such that it could be on site within 6 hours, and a third within 24 hours. These second and third systems were generally not stationed on site, but were in a ready state to transport to the scene if needed.

4.5.2.3 Equipment

As a result of the cooperation and agreements between Government, municipalities, industry and other groups, there is an extensive network of response equipment available (Brekne et al, 2005):

- More than 13 000 metres of offshore booms
- More than 24 000 metres of coastal booms
- More than 10 000 m³/hr of skimming capacity
- More than 30 dedicated oil-recovery vessels

- 2 000 qualified personnel

Government

There are 16 contingency depots with oil-spill equipment (booms, skimmers, pumps, clothing, etc), trained personnel (each have a technical supervisor and ten task force personnel) and small boats dispersed along the Norwegian coast. Various coastal authorities have inshore booms and skimmers available.

In addition to four Government oil-pollution control vessels there are eight coast guard vessels that are permanently equipped with oil-recovery equipment. Naval defense vessels are on contract and can be used for oil-recovery, transportation or as offshore command vessels. Vessels of opportunity (e.g., fishing boats) and vessels from the civilian coastal patrol can also be used. An aircraft equipped with side-looking airborne radar and a photo-phone system allows tracking in good and poor visibility (day/night). Radar satellites (by Kongsberg Satellite Services) give info on major spills within 2 hours of satellite overpass. Also, as mentioned previously there is a Marine Resource Database with maps highlighting coastline sensitivity (Norwegian Coastal Administration; ITOPF Norway, 2008).

The NCA's Department of Emergency Response is located in Horten, with two small stations at Tromsø and Mongstad.

Private Industry

NOFO has several large supply ships at their disposal that can be converted for oil recovery at short notice. They have 5 equipment depots (Stavanger, Monstad, Kristiansund, Traena, Hammerfest) all of which have large heavy-duty containment and recovery systems. NOFO has contracted helicopters with infrared photography that can be linked with responding ships (for day and night operations). The oil industry maintains 3 large stockpiles (including vessels) at oil-refinery terminals of Statoil Mongstad and Esso Slagen and the crude oil terminal of Norsk Hydro Sture. Several bunker stations have small amounts of equipment (ITOPF Norway, 2008).

There is little call for cleanup contractors in Norway due to the extensive range of equipment by Governments and industry.

A map locating equipment depots, both Government and industry, can be found in Figure 24.



Figure 24 - Main Equipment Depots in Norway

Source: (Bjerkemo, 2010)

4.5.2.4 Training

This section outlines available and required training courses offered by Government and industry as well as response exercises and experience with previous spills.

Courses

The following are the six most common training courses offered and they are required to uphold the competence of the Governmental, municipal and industrial response teams (Bjerkemo, 2010). The courses encompass the range of focus in the IMO model training courses.

- 1) Introduction (basic) training course - Designed for all personnel involved in the contingency agencies.
- 2) Team leader course - A 4-day training course, divided between lectures and practical training, including hands-on with booms and skimmers from the sea and the shoreline.

- 3) On-scene Commander level course (for sea, coast or land responses) - A 3- to 4-day course that focuses on operational management and tactical use of response equipment. Courses are tailored for the sea, coast or land responses.
- 4) Incident Command course - A 3-day course with one day of lectures and two days of practical training, consisting of table-top exercise for duty familiarization and role-playing exercises for high stress situations.
- 5) Course for Governmental depot task force and technical supervisors - A 4-day introductory course for newcomers and annual refresher/upgrade courses.
- 6) Course for NOFO depot task force - Offered by NOFO to supplement the industry's own training in incident command and on-scene command for their staff. Annual NOFO courses are also offered on various topics.

The World Wildlife Fund (WWF) operates a training program unique to Norway called the Clean Coast program. It trains members of the public as oil-spill response volunteers, enabling them to become competent and effective members of a cleanup effort. As per the WWF website, the objective of the Clean Coast program is to *“reduce the environmental and economical consequences of an oil-spill along the Norwegian coastline, by establishing a competent and operative unit of committed volunteers”* (WWF).

The Clean Coast program conducted its first training course in November of 2005 and has held three to six 3-day courses per year, each designed for 20 to 30 people at a time. The courses are offered at various locations around Norway and are planned in cooperation with coastal authorities and NordNorskBeredskapssenter (experienced trainers). The courses have three major components including safety, practical oil-spill cleanup and beach sanitation, and nature values and environmental risk in coastal transport and petroleum business. The WWF contacts all trained volunteers in the case of an oil-spill (WWF).

Response Exercises

NCA exercises are tailored for the respective needs of the municipalities and Governmental contingency agencies. Each depot has two annual exercises. In 2010, NCA will conduct a total of 11 exercises and training courses with municipal/inter-municipal agencies. There are annual large integrated exercises incorporating personnel and equipment from Government, municipalities, industry and the coast guard ensuring the national contingency system is effective. Internationally, there are a number of annual exercises based on different international agreements (Bjerkemo, 2010).

In addition to various courses, NOFO's training program includes:

- Monthly field exercises including members
- Monthly table-top exercises including members
- 2 to 4 full-scale exercises involving all partners per year
- Minimum of 2 team-building sessions with contingency groups per year

The full-scale exercises involve 200 to 500 personnel and significant technical resources and have been held at least twice a year since the implementation of the new oil-spill contingency regime in 2000. NOFO trains six contingency groups from the member companies that form the core of their emergency response operations (Brekne et al, 2005).

Previous Oil-spill Response Experience

The largest blowout in North Sea history was from Norway's Ekofisk oil field in 1977, which spilled between 11 000 and 17 000 tonnes. This blowout was the motivating factor behind the initial creation of Norway's current response strategy and policy. More recently, in 2000 a Norwegian freighter spilled about 100 tonnes of fuel oil, requiring extensive containment, recovery and coastline operations. In 2001, a land-based spill of 750 tonnes from a storage facility reached the sea, of which 100 tonnes were recovered from the land and 190 from the sea. In 2004, the *Rocknes* vessel capsized and spilled 300 to 400 tonnes near Bergen and required 145 personnel and 30 vessels for the cleanup operation.

In 2009, the NCA was involved in three oil-spill response operations, out of the total 1100 acute pollution notifications they received (most of which were small and handled effectively by the respective polluters and municipalities). The large spills included the *Crete Cement* incident (in the Oslofjord), the Russian tanker *Petrosavodsk* (at Bear Island) and the vessel *Full City* (southeast coast) (Bjerkemo, 2010).

4.5.2.5 International Cooperation and Agreements

Norway has ratified MARPOL Annexes 73/78, III, IV, and V as well as OPRC 1990. They are also party to CLC 1992, Fund 1992, Supplementary Fund and Bunker.

Norway is part of the Bonn Agreement, which pertains to oil-spill response in (countries bordering) the North Sea, as well as the Norway-Russia Agreement, which pertains to response situations in the Barents Sea. They are also part of the Norbit Plan, and the Copenhagen Agreement.

4.5.2.6 Overall Commitment

In the final part of this section the commitment of Norway to oil-spill response is discussed. Funding and preparedness improvement, including research and development, efforts are presented followed by a summary of the country's overall preparedness for spill-response.

Funding

The national Norwegian budget has given priority to the improvement of the Governmental oil-spill preparedness (Bjerkemo, 2010). NOFO has invested roughly \$30 million U.S. into research, development and manufacturing of new response equipment and systems (Brekne et al, 2005).

Improving Preparedness (Including Research and Development)

Lessons learned from annual large integrated response exercises are incorporated into the national contingency system to ensure it is effective.

Recent budgets have allowed the replacement of old response equipment and the procurement of new equipment. Also, based on responses to various incidents (most recently the three that occurred in 2009) the NCA has increased not only the amount of response equipment, but also the training and exercises crucial for an effective incident response (Bjerkemo, 2010).

For several years legislation has required a continuous improvement in emergency oil-spill response. Also, a review of the "Rules and regulations for the petroleum activities" stated environmental risk should be reduced as much as possible. Due in part to these reasons, NOFO has undertaken an extensive research and development process (Brekne et al, 2005).

Continuous and proactive research and development is undertaken by NOFO due in no small part to a precedent set in 1998 - weathering studies of crude oil from a specific field showed that existing skimmers would be ineffective in combating the oil so the Norwegian authorities shut down production until a new effective skimmer was developed and made available. This process took several months. The fact that all equipment, no matter how well maintained, will eventually need replacement also motivated their R&D initiative (Brekne et al, 2005).

NOFO's R&D program has three phases (Brekne et al, 2005):

- 1) Initial phase with pilot studies - This includes the development of new systems/equipment, the redesign of and the development of new concepts for existing systems/equipment, the review of the current supply base and equipment distribution.

- 2) Full-scale testing - This includes in-situ testing involving oil-on-water exercises with strict controls and monitoring.
- 3) Replacement of older equipment - Some examples of implemented improvements have been:
 - Ship-based radar system for detection of oil-spills
 - Redesign of helicopter based dispersant system
 - Development of two new booms
 - i. Lower weight, automated inflating upon deployment, reduced deployment time, etc.
 - ii. High-speed towing and recovery
 - Redesign of a skimmer for more effective and higher capacity use in a wider range of conditions on oil with a wider range of properties including contracts with manufacturers

Summary of Norway's Preparedness, Training and Commitment

Norway's response strategy revolves around the National Oil-spill Contingency System. The Norwegian Coastal Administration (NCA) is responsible for major response preparedness while the Norwegian Clean Seas Association for Operating Companies (NOFO) represents the offshore industry in responses. Inter-municipal areas also develop their own contingency plans, as do land-based oil-handling facilities.

Norway's response policy focuses on containing and recovering oil as close to the spill as possible. There are many oil barriers, as part of the response plan, that attempt to prevent spilled oil from reaching the shore. Dispersants are used to supplement a response but the Norwegian Pollution Control Authority must approve their use.

The contingency system is highly developed with Government and industry response equipment stockpiles distributed throughout the country. Various vessels and aircraft, thousands of metres of booms and roughly 2 000 trained personnel are among the incident response resources.

The six common training courses offered by the Norwegian Government range from a basic training course to incident command to supplementary courses for industry personnel. The World Wildlife Fund operates a training program unique to Norway aimed at training members of the general public for oil-spill response.

Each response depot has two response exercises each year. Full-scale industry exercises involve 200 to 500 personnel and significant technical resources and are held at least twice a year. There are annual large integrated exercises incorporating personnel and equipment from Government, municipalities, industry

and the coast guard ensuring the national contingency system is effective. NOFO's training program includes various field and table-top exercises.

While Norway has experience responding to several oil-spills, most have been less than 1 000 tonnes. The protection of the Norway's vast coastline has motivated quick and effective responses to any marine based spills.

Norway is party to many international conventions and agreements.

Funding for oil-spill response preparedness has been given priority status in the national Norwegian budget, allowing for improved response equipment, training and exercises.

4.5.3 United Kingdom

The United Kingdom, like the other countries examined, manages a range of oil-spill contingency plans with equipment and personnel in various locations around the coast. Its national response strategy is the primary responsibility of the Government's Maritime and Coastguard Agency. The United Kingdom has experience dealing with various oil-spills and is party to many international conventions and agreements.

Information presented about the U.K.'s preparedness, training and commitment is based largely on (MCA CPR), (MCA, 2006) and (ITOPF U.K., 2008), among other sources.

4.5.3.1 National Oil-spill response Strategy and Policy

The National Contingency Plan for Marine Pollution from Shipping and Offshore Installations (the National Contingency Plan) was most recently updated in 2000 and 2006 with lessons learned during spills and exercises. Emphasis is placed on training local authorities, most of which have their own response plans. It's important to note that most spills in U.K. waters reach the shore (MCA, 2006).

The Maritime and Coastguard Agency (MCA) is the competent national authority that responds to marine pollution. The MCA's Counter Pollution and Response Branch (CPR) are based on regional response with central operational, technical and scientific support. There are Regional Operation Managers - Counter Pollution and Salvage (ROM-CPS) in three regions: Scotland and Northern Ireland; Wales and the West and; the Eastern Region. The CPR's headquarters is in Southampton, where they have scientists, mariners, cost-recovery specialists and logistical support specialists (ITOPF U.K., 2008).

Ports, harbours and oil-handling facilities are required to prepare and submit oil-spill response contingency plans to the MCA for approval (with updates every five years) and are also required to be able to handle up to a Tier 2 spill in their jurisdiction. Offshore installations have similar requirements for spills up to the Tier 3 level. The MCA has produced guidelines and advice on developing contingency plans (MCA CPR).

Typically, an incident is initially reported to one of 19 coastguard stations around the U.K. The coast guard then initiates search and rescue operations, if required, before any other forms of response. The coast guard informs the ROM-CPS of any potential pollution, who then determines the required course of action, begins the response and notifies the CPR. If the spill is large enough, Southampton's Marine Emergency Information Room may be activated (MCA CPR).

Up to three main control centres can be setup depending on the specifics of the spill: (1) Salvage Control Unit, (2) Marine Response Unit and, (3) Shoreline Response Centre. An Environmental Group that provides advice to the control units can be setup if there's a threat to marine/coastal environment. Representatives from conservation authorities, regulators and the Government's fisheries department are members of said group (MCA CPR).

The MCA has outlined the processes, roles and command structure for responses at sea, in harbours, and on the shoreline in the National Contingency Plan (MCA, 2006).

Response Policy

Spills in the U.K. are categorized according to the Tiered Response system; however Tiers are not given generic quantification as assessments are made on the basis of potential risks in specific areas. The Tiers have the following definitions (MCA CPR):

- *Tier 1 - A small operational spill employing local resources during any cleanup.*
- *Tier 2 - A medium-sized spill, requiring regional assistance and resources.*
- *Tier 3 - A large spill, requiring national assistance and resources. The National Contingency Plan will be activated in this case.*

The U.K. tends to let oil-spills disperse naturally unless there is a threat to coastlines, fisheries or important bird populations. Dispersants are a primary response if advantages outweigh disadvantages (i.e., cost and ecological damage). Since 1986, only approved dispersants may be used, the licenses for which are issued by the Department of the Environment, Food and Rural Affairs. If the use of dispersants is not suitable, slick movement is monitored and containment and recovery proceed along with shoreline protection/cleanup (ITOPF U.K., 2008).

4.5.3.2 Guidelines and Regulations for Offshore Operators

The Department for Energy and Climate Change (DECC) is the U.K. Government department with responsibility for regulating the offshore oil and gas industry. Oil and gas activities sit within the Energy Development Unit (EDU) with two groups managing environmental aspects of offshore oil and gas

activities - Licensing Exploration and Development (EDU-LED) and Environment & Decommissioning (EDU-ED). DECC has regulatory responsibility for environmental protection from the low water mark out across the U.K. continental shelf. They are the principal environmental regulator for the offshore oil and gas industry for every stage of activity from licensing, to exploration, through new projects and operations to decommissioning. DECC also has, on behalf of the Maritime and Coastguard Agency (MCA), an oil-spill planning regulatory function for the offshore oil and gas industry. Key legislation for which DECC has enabled powers are the *Petroleum Act 1998* and the *Pollution, Prevention and Control Act 1999*.

The DECC have published detailed guidelines on the requirements for contingency plans for offshore oil and gas operators. The guidelines clearly favour the use of dispersants as a strategy for offshore response, recognizing the limitations of containment and recovery in open-water conditions. A containment and recovery response is required, however, for oils that are not amenable to dispersion or when environmental sensitivities are threatened and natural dispersion is unlikely to mitigate the effects of a spill. Otherwise, the main strategies for response are surveillance and application of dispersants.

In developing an Oil Pollution Emergency Plan (OPEP), operators must develop an inventory of hydrocarbons that could potentially be spilled. These are then categorized according to the ITOPF classification system (Table 11), and then used, along with spill-volume categories, to establish time and material standards for response. Operators must also identify credible potential pollution scenarios including a major incident such as a blowout, and lesser incidents such as fuel releases. The scenarios must be used to assess the potential environmental impacts to ensure that a timely and adequate oil-pollution response is developed within the OPEP. This should include: a base-line description of the surrounding environment highlighting sensitive components; and all environmental sensitivities at risk with seasonal variations in U.K. coastal waters and, if threatened, those of Ireland or Continental Europe.

Table 11 - ITOPF Category Grouping for Hydrocarbons

Oil Type	ITOPF category	Property	Example
1	Group I	SG < 0.8	kerosenes / gasolines
2	Group II	SG 0.8 to 0.85	light crude, gas oils
3	Group III	SG 0.85 to 0.95	medium crude
4	Group IV	SG > 0.95 or Pour Point > 30 degrees	heavy and/or waxy crude

The requirements for surveillance (and modeling, by inference) include the ability to track oil pollution, estimate its volume and behaviour, estimate its trajectory and fate, and estimate potential effects with regard to local and regional sensitivities. Note that fate is used to describe the ultimate behaviour of the oil (does it evaporate, does it disperse). Methods used may include helicopters or dedicated aerial

surveillance aircraft. Crew-change helicopters may be used for initial assessments, but they are not acceptable for longer-term use due to their other commitments. Minimum specifications for surveillance aircraft include: Infrared Scanner imaging equipment; Ultra Violet Scanner imaging equipment; navigation equipment (e.g., Global Positioning System (GPS)) to facilitate control over countermeasures; and trained and experienced operators.

As noted above, specific guidance on time and material standards are given (Table 12); these standards were developed in conjunction with various Government agencies with an interest in offshore activities as well as industry and response specialists.

If the dispersibility of hydrocarbons cannot be demonstrated, other strategies (i.e., containment and recovery and shoreline protection) must be identified to ensure an effective response.

For installations within 25 miles of the coastline, the response time requirement is more rigorous, depending on the oil types and specified scenarios. In addition to the requirements noted in Table 12 are the following requirements:

- An ability to begin applying dispersant within 30 minutes
- A resident inventory of dispersant for a 25-tonne spill
- Additional tier 2 resources on scene within half the time taken for the oil to reach shore in 30-knot onshore winds
- A shoreline protection plan

Incident reporting and training requirements are also specified and relatively frequent exercises are required. For example, Tier 1 dispersant-spraying equipment and oil-recovery equipment must be deployed offshore annually, and Tier 2/3 resources must be deployed every five years.

4.5.3.3 Equipment

Government

The MCA has arrangements for several aircraft accessing stockpiles of dispersants at 14 airfields. They have two surveillance aircraft with remote sensors that are used to monitor illegal discharges and assist response operations. Locations at Southampton and Inverness house shoreline protection/cleanup equipment including booms, skimmers, dispersant-spraying equipment, hot water washers and all-terrain vehicles. There are also booms located at six other sites and marine counter pollution equipment, including salvage, at another two sites (ITOPF U.K., 2008). Table 14 highlights what kind of equipment is stored at locations around the U.K.

Table 12 - Minimum Standards for Oil Pollution Response, Installations > 25 miles Offshore

Oil Quantity (Estimate)	Oil Type	Response Times		
		Aerial Surveillance Capability	Block Specific Vulnerability	
			Sensitive areas*	Other areas
0 to 25 tonnes	1	Within 4 hours	Monitor and natural dispersion - (dispersant requirement assessed on case by case basis)	Monitor and natural dispersion - No dispersant requirement
	2, 3 and 4		Monitor and dispersant within 1 hour	Monitor and dispersant available but no “within 1 hour requirement”
25 to 100 tonnes	1		Monitor and natural dispersion - (dispersant requirement assessed on case by case basis)	Monitor and natural dispersion - No dispersant requirement
	2, 3 and 4		Monitor and dispersant within 2 hours	Monitor and dispersant available but no “within 2 hour requirement”
100 to 500 tonnes	1		Monitor and natural dispersion - (dispersant requirement assessed on case by case basis)	Monitor and natural dispersion - No dispersant requirement
	2, 3 and 4		Monitor and dispersant within 6 hours	Monitor and dispersant within 6 hours
>500 tonnes	1		Monitor and natural dispersion - (dispersant requirement assessed on case by case basis)	Monitor and natural dispersion - No dispersant requirement
	2, 3 and 4		Monitor and dispersant within 18 hours	Monitor and dispersant within 18 hours
* Areas judged to be highly vulnerable to seabird effects				

Source: UK DECC 2009

Table 13 - Dispersant Combat Rate Requirements

Estimated Oil Pollution Quantity	Average Combat Rate
0 to 100 tonnes	10 tonnes per hour
100 to 500 tonnes	50 tonnes per hour
>500 tonnes	More than 50 tonnes per hour

Source: UK DECC 2009

The MCA has an interactive Coastal and Marine Resource Atlas designed from maritime contingency planning and response as part of the Multi-Agency Geographic Information for the Countryside, a coastal and marine resources atlas that can be used as a tool for oil-spill contingency plans (MAGIC).

A map of MCA regions including resources is shown in Figure 25.

Table 14 - Equipment Stockpiles and Locations in the U.K.

Equipment	Locations
Counter pollution at sea equipment - including salvage and chemical response equipment	Milford Haven, Huddersfield, Perth
Shoreline clean-up equipment	Milford Haven, Huddersfield, Perth
Booms	Milford Haven, Huddersfield, Perth, Oban, Llanelli, Truro, Ely, Darlington and Belfast
Dispersants	14 locations around the U.K.

Source: Modified from (MCA CPR)

Private Industry

Most major terminals have their own response equipment, including dispersants. The Thames Oil-spill Control Association operates equipment for response in the Thames estuary. Several oil companies have additional stockpiles of response equipment. There is a private contractor in Aberdeen that is available for response, though primarily for the offshore drilling industry (ITOPF U.K., 2008).

Oil-spill response and East Asia Response Ltd. operate offices in the U.K., Singapore and Bahrain. These house major stockpiles of response equipment primarily for worldwide pollution incidents, having cargo aircraft on permanent standby (ITOPF U.K., 2008).

4.5.3.4 Training

This section outlines available and required training courses offered by Government and industry as well as response exercises and experience with previous spills.

Courses

Meeting the requirements of the OPRC 1990 Convention, the independent Nautical Institute (NI) is responsible for the accreditation of oil-spill response training courses on behalf of the MCA's Counter Pollution and Response Branch. Table 15 lists all of the courses that are accredited by the NI. In all cases, the U.K. standards meet, and typically exceed the IMO baseline recommendations, and thus training certificates for accredited courses may also quote the course's IMO equivalents (MCA NI, 2008).

The Counter Pollution Branch of the MCA provides two areas of Nautical Institute accredited training, at no cost, for local authorities. The first is a 4-day course intended for local authority management staff involved in contingency planning and oil-spill response and is offered four times a year at various locations around the U.K. (MCA CPR). The second is a 2-day Beach Supervisor course intended for local authority staff that would be involved in the hands-on supervision of beach cleanup operations and protective booming operations and is generally offered eight times a year. The former training course is

offered to individuals who may apply to attend a regional course at various times of the year, whereas the latter courses are provided for individual local authorities on a request basis (MCA CPB, 2009).



Figure 25 - Map of MCA Regions and Resources

Source: Modified from (MCA, 2006)

The U.K. Department of Energy and Climate Change (DECC) that replaced the Department for Business, Enterprise and Regulatory Reform (previously the Department of Trade and Industry) also has training requirements for offshore operators (DECC, 2009). These courses are also accredited by the NI and listed in Table 16.

Table 15 - NI Accredited Course Table

Awareness	Minimum Duration	U.K. Course Type	Target Audience	IMO Equivalent
Familiarization and preparedness for oil-spill response	8 hrs	MCA 1/1p Foundation (Management)	Management, public relations	
Operators role in oil-spill response		MCA 1/1p Foundation (Operator)	First responder - absorbent response	
Basic use of Tier 1 equipment including practical deployment	12 hrs	MCA 2/2p	First responder - equipment operator	None
Ability to act as supervisor in oil-spill response	24 hrs	MCA 3/3p	Supervisor	IMO 1
Ability to prepare for, manage or take part in the management of an oil-spill response	32 hrs	MCA 4/4p	Assistant Harbour Master, Harbour Master of small ports, members of a response management team	IMO 2
Ability to act as an Executive Commander / Incident Controller including command and control	16 hrs	Endorsement up to course type MCA 5/5p	Those with previous training up to type 4/4p	IMO 3
Ability to act as an Executive Commander / Incident Controller starting from basic entry	40 hrs	MCA 5/5p	Harbour Master of large ports or response team manager	IMO 3
Refresher	8 hrs	MCA /E/ R	Those who have undertaken training not more than 3 years previously	None
National Training Course on Oil Pollution, Contingency Planning and Response	32 hrs	LA1	Local authority staff with oil-spill management responsibilities	None
Regional Training Course on Oil Pollution, Contingency Planning and Response	16 hrs	LA2	Local authority employees who would be involved in practical cleanup operations	None

Source: (MCA NI 2008)

Table 16 - U.K. DECC Training Courses

Course	IMO Equivalent	Duration	Refresher
Offshore On-scene Commander (OIM) U.K. DECC Level 1	None	4 hrs	Repeat 3 yearly
Corporate Management U.K. DECC Level 2	None	4 hrs	Repeat 3 yearly
DECC Onshore Emergency Responder U.K. DECC Level 3	None	24 hrs	1 day / 3 yearly
Onshore Emergency Responder U.K. DECC Level 4	IMO Level 2	32 hrs	1 day / 3 yearly

Source: (DECC 2009)

Other than the two courses mentioned above, all NI and DECC oil-spill response training courses are offered by private agencies such as Oil-spill response (OSR, 2010), at various times throughout the year in different regions around the U.K. and the world (including Singapore and Bahrain).

A training package, complete with presentations and speaker's notes, is available online for any organization that would like to provide training to their staff on the role and activities of the Environmental Group in the NCP. The training claims that by the end of the workshop an attendee "*will be able to provide support to the incident as an Environmental Liaison Officer, as part of the Environment Group, or as 'behind the scenes support'*" (NCP Environmental Group Training Package).

Response Exercises

There are four general types of the MCA's maritime emergency response exercises, summarized below. Each of these can be modified to suite a specific need or situation and can span a broad range of involvement of agencies, personnel and equipment (MCA Incidents and Exercises).

- Full-scale live exercises, which involve the participation of search and rescue teams, oil-spill response resources along with local, port and shipping authorities.
- Co-ordination exercises, which involve the participation of command and co-ordinating agencies, operating remotely from each other, but do not include the mobilization of equipment and other resources.
- Table-top exercises, which involve response personnel meeting to study a particular incident and discuss effective responses.
- Communication exercises, which involve the periodic use of all means of communication between various response personnel.

As per (MCA, 2002), "*Tier 3 exercises, having national / international implications, and which require the activation of the National Contingency Plan, are held at regular intervals. They are generally organized by MCA. It is likely that the exercise will contain elements of Search and Rescue, salvage and pollution response involving the deployment of containment and recovery equipment. Whilst the number of ports which can be directly involved is limited, exercise reports are made available to the ports industry trade associations...*"

The MCA requires that each port/harbour authority must hold an Incident Management Exercise (i.e., full oil-spill response exercise), simulating a Tier 2 incident, at least once every three years. The lessons learned from the exercises are to be incorporated into a port/harbour's contingency plans, in accordance with each plan's five-year life cycle. MCA (2002) provides guidance on planning and conducting

exercises designed to evaluate an existing contingency plan and provide training to personnel. Smaller scale exercises having a more defined scope are also required at varying times. A typical program of exercise frequency can be found in Table 17.

Table 17 - Typical Program of Exercise Frequency

Exercise Type	Frequency
Notification Exercise	Twice per year
Table-top Exercise (may incorporate mobilization and deployment of local response equipment)	Once per year
Incident Management Exercise (will incorporate mobilization and deployment of resources up to Tier 2)	Once every 3 years

Source: Modified from (MCA, 2002)

Previous Oil-spill Experience

The U.K. has experienced several major oils spills. In 1993, the tanker *Braer* spilled 85 000 tonnes of crude near the Shetland Islands and was for the most part left to naturally disperse. In 1996, *The Sea Empress* spilled 72 000 tonnes of crude and required extensive dispersants, containment and recovery equipment as well as beach cleanup. Other notable spills include *Torrey Canyon* (1967), which spilled up to 119 000 tonnes and *Rosebay* (1990) spilled 1000 tonnes of crude.

4.5.3.5 International Cooperation and Agreements

The United Kingdom has ratified MARPOL Annexes 73/78, III, IV, V and VI along with OPRC 1990. They are also party to CLC 1992, Fund 1992, Supplementary Fund, and Bunker.

The U.K. is part of the Bonn Agreement, which pertains to oil-spill response in (countries bordering) the North Sea, as well as the Manche Plan (with France) and the Norbit Plan, a bilateral contingency plan with Norway. There is a draft agreement with Ireland for the Irish Sea as well as the European Community Task Force.

4.5.3.6 Overall Commitment

In the final part of this section, the commitment of the United Kingdom to oil-spill response is discussed. Funding and preparedness improvement, including research and development, efforts are presented followed by a summary of the country's overall preparedness for spill-response.

Funding

According to the MCA's Annual Report (MCA, 2009) the counter pollution program cost £1 062 000 in 2007-2008 and £453 000 in 2008-09, while the MCA's entire 'Cleaner Seas' focus area, under which oil-

spill response falls is budgeted to cost over £15 million and £16 million in 2009-2010 and 2010-2011, respectively.

Improving Preparedness (Including Research and Development)

The contingency plans of ports, harbours and oil-handling facilities must be updated every five years based on lessons learned from regular exercises.

As of 2008, the MCA's annual R&D budget was approximately \$1.5 million U.S. Much of the research led by the MCA is collaborative work that attracts funds from both the public and private sector. The main purpose of the research is to better position the U.K. for the preparedness for, and response to, maritime oil and chemical pollution. Recently completed and approved projects have included (Davidson et al, 2008):

- The effects of various dispersant on varying oil viscosity
- Comprehensive look at the ecological effects of dispersant use
- U.K. coast and marine resource atlas
- New GIS platform to represent potentially polluting wrecks
- A very heavy fuel oil risk assessment
- The design of oily waste treatment infrastructure capable of handling large quantities
- Development of a standard shoreline cleanup assessment reporting protocol

Summary of the United Kingdom's Preparedness, Training and Commitment

The United Kingdom's response strategy revolves around the National Contingency Plan for Marine Pollution from Shipping and Offshore Installations. The Maritime and Coastguard Agency (MCA) is responsible for major oil-spill preparedness, with regional operations managers. Responses are based on regional operations and central support.

The U.K.'s response policy employs the Tiered Response system. Ports, harbours and oil-handling facilities are required to have oil-spill response contingency plans and are required to be able to handle up to a Tier 2 spill in their jurisdiction. Offshore installations have similar requirements for spills up to the Tier 3 level. The MCA has produced guidelines and advice on developing contingency plans. Major response policy allows natural dispersion unless sensitive ecosystems are under threat. A Net Environmental Benefit Analysis is used to determine if dispersants are used as a primary response. Only approved dispersants may be used.

The MCA has access to several aircraft and stockpiles of dispersants and 14 airfields around the country. Locations at Southampton and Inverness house shoreline protection and cleanup equipment. There are also booms housed at several other locations around the country. Most major terminals and oil companies have their own stockpiles of response equipment. There is a major international stockpile of equipment located at Southampton.

The independent Nautical Institute is responsible for the accreditation of oil-response training whereas private companies provide most of the training. A comprehensive range of training courses, which go beyond the scope of the IMO model training courses, are accredited and offered. An online-training package is available to train staff to support the Environmental Group involved in a response.

There are four general types of response exercises that can be modified to suite specific needs and situations. National Tier 3 exercises are held at regular intervals, incorporating a wide range of agencies. Port and harbour authorities must hold full Tier 2 oil-spill response exercises once every three years. The lessons learned from these exercises are incorporated into contingency plans on a five-year cycle. Other smaller scale exercises are also held. The U.K. has experience responding to several major oil-spills, the lessons learned from which have heavily influenced response legislation.

The U.K. is party to many international conventions and agreements.

The Government funds the National Contingency Plan, but recovery costs are paid for by the polluter. As of 2008, the MCA's annual research and development budget was \$1.5 million U.S. Projects include everything from dispersants, to a marine resource atlas, and risk assessments to various other response systems.

4.5.4 Australia

Australia, like the other countries examined, manages a range of oil-spill contingency plans having equipment and personnel in various locations around the coast. Its national response strategy is the primary responsibility of the Australian Maritime Safety Authority (AMSA), a Governmental agency, and the Australian Marine Oil-spill Centre, an industry agency. Australia has experience dealing with various oil-spills and is party to many international conventions and agreements.

Information presented about Australia's preparedness, training and commitment is based largely on (AMSA, 2004), (AMSA, 2008), (ITOPF Australia, 2009) and other AMSA sources.

4.5.4.1 National Oil-spill Response Strategy and Policy

The Australian Maritime Safety Authority (AMSA) manages Australia's National Plan to Combat Pollution of the Sea by Oil and Other Noxious and Hazardous Substances (the National Plan). The AMSA

is primarily responsible for oil-spill response within the Commonwealth jurisdiction, which lies beyond three nautical miles from shore, whereas individual states/territories and local authorities are responsible for waters within three nautical miles of shore.

As per (AMSA, 2008), “*The National Plan provides a national framework for responding promptly and efficiently to marine pollution incidents by designating competent national and local authorities, and maintaining:*

- *the National Marine Oil and Chemical Spill Contingency Plans;*
- *detailed state, local and industry contingency plans;*
- *an adequate level of strategically positioned response equipment;*
- *a comprehensive national training program, including conducting regular exercises.”*

The National Plan Management Committee is in charge of strategic oversight of the National Plan. This involves setting policy, overseeing formal arrangements between stakeholders and advising the Australian Transport Council on issues relating to funding of the National Plan (AMSA, 2004).

The National Plan Operations Group controls operational aspects such as equipment, training, contingency planning and exercises and has established working groups to address specific issues related to oil, chemicals and the environment (AMSA, 2004).

The National Plan is supported by the National Maritime Emergency Response Arrangements (NMERA), which ensure the continuing provision of sufficient maritime emergency towage capacity and the appointment of a single national decision maker to coordinate response measures, known as the Maritime Emergency Response Commander (AMSA, 2004).

As part of the national strategy each state/territory has its own agencies responsible for local administration and operation of the National Plan within their jurisdictions. Each state/territory also has its own administrative and legislative requirements governing oil-spill response and a Marine Pollution Controller that is in charge of an incident in their respective jurisdictions. An Incident Controller manages the operational response (ITOPF Australia, 2009).

Individual oil-industry facilities maintain their own response equipment for local spills. The Australian Marine Oil-spill Centre (AMOSOC), a subsidiary of the Australian Institute of Petroleum, provides the central Tier 3 stockpile of oil-spill response equipment, used primarily when a required response is beyond an individual company’s capabilities. AMOSOC also coordinates the industry’s mutual aid agreements and is based in Geelong, Victoria.

The REEFPLAN contingency plan has been developed specifically for incidents that occur in the region of the Great Barrier Reef. The Queensland State Government, in cooperation with AMSA and the Great Barrier Reef Marine Park Authority, is primarily responsible for this region (ITOPF Australia 2009).

Response Policy

Each spill requires the development of its own plan of action and response decisions based on extensively proven cleanup options. The national plan uses the Tiered Response system for categorizing the response requirements of an incident. In Australia, the Tiers are defined as follows (ITOPF Australia, 2009):

- Tier 1 - spills up to 10 tonnes
- Tier 2 - spills between 10 to 1 000 tonnes
- Tier 3 - spills above 1 000 tonnes

When using dispersants, all environmental effects are to be considered. Their use requires quick decision making in order to prevent oil from reaching the shore. Australia has a Fixed Wing Aerial Dispersant Capability program in place, which consists of large agricultural aircraft having dispersant capacities between 1 850 and 3 100 litres. These spraying arrangements are complimented by helicopters, which are confined to work close to the shore (AMSA, 2004).

Australia uses booms and skimmers to contain and recover spilled oil. They also use sorbents as alternatives or to complement booms and skimmers, especially in small spills. The National Plan allows for natural dispersion and degradation accompanied with monitoring as an acceptable response, depending on the specifics of the situation. Removal of a leaking vessel away from any threatened resources is also an option (AMSA, 2004).

4.5.4.2 Equipment

Government

Any oil-spill response equipment related to the National Plan, AMOSC and other industry sources is listed in the Marine Oil-spill Equipment System database (ITOPF Australia, 2009).

AMSA has established regional resource centres of equipment and material for use in spill-response, and maintains a database of all National Plan equipment. The capability includes offshore and near-shore containment and recovery equipment, a fixed wing aerial dispersant capability, and a dispersant supply for Tier 2 and Tier 3 incidents. They have a stated target response capability of 21 000 tonnes. Other planning and response areas handled by AMSA include the management of the national Oil-spill response

Atlas and Oil-spill Trajectory Model. Local Port Authorities have some equipment for smaller, Tier 1 spills (AMSA, 2004).

As part of the NEMRA, a dedicated emergency towage vessel based in Cairns is available to respond to offshore emergency situations. AMSA also has multiple vessels contracted to be available in the event of an incident as well as the option to hire suitable vessels that happen to be in the area, known as “vessels of opportunity” (AMSA, 2004).

AMSA has a contract for six prime and two secondary large agricultural aircraft on 4-hour notice for dispersant-spraying operations. This is funded jointly by the AMSA and the oil industry. They are located in Queensland, New South Wales, Victoria, South Australia and Western Australia. There are also other aircraft contracted for responses in other locations, but their use depends on availability (ITOPF Australia, 2009).

Australia employs a computer-based Oil-spill Trajectory Model to simulate movement of oil-spills. They also have a National Plan Oil-spill response Atlas, which is a digital mapping system used to overlay various types of data (e.g., biological, cultural, geomorphological, socio-economic) in order to determine the range of impacts an oil-spill has on the region (AMSA, 2004).

Government stockpiles undergo audits and updating on a regular basis (AMSA, 2009).

Private Industry

Whereas individual oil companies and oil-handling facilities have equipment adequate for a Tier 1 response, AMOSC houses over \$10 million of oil-spill combat equipment and materials at their headquarters in Geelong, Victoria and also at a location in Exmouth, Western Australia. The inventory includes a mix of offshore and nearshore containment and recovery equipment, dispersant and application equipment, and shoreline protection equipment. Nine participating oil companies and other subscriber companies that carry out the vast majority of the oil and gas production, offshore pipeline, terminal operations, and tanker movements around the Australian coast finance them. This equipment is intended for use in larger spills and is fully containerized for rapid handling and deployment to anywhere in Australia, typically within 24 hours (AIP). The Australian Marine Oil Spill Centre (AMOSC) is a subsidiary of the Australian Institute of Petroleum Ltd (AIP).

4.5.4.3 Training

This section outlines available and required training courses offered by Government and industry as well as response exercises and experience with previous spills.

Courses

AMSA, the regional Governments and industry run training courses for anybody likely to be involved in a spill-response. Training is given based on one of three levels that resemble (but do not exactly follow) the IMO's model training courses (AMOSC Training):

- 1) Senior management level training for those in Government or industry having high-level decision capabilities. AMOSC offers the *Course in Oil-spill response Command and Control* to suit these needs.
- 2) Middle management level training for operational response managers, environment and scientific coordinators. AMOSC offers the *Course in Oil-spill response Management* to suit these needs.
- 3) Operator level training for those appointed as site managers as well as those undertaking onsite cleanup and support operations. AMOSC offers the *Course in Oil-spill response Operation* to suit these needs.

Table 18 shows the training schedule offered by various National Plan agencies, AMOSC and Maritime New Zealand, for July 2010 through June 2011. Many of the high-demand courses are offered at various times throughout the year, sometimes at different locations. They also offer a Course in Oil-spill response Awareness for those who have an interest in the basics of response and management of oil-spills, but it is not offered between July 2010 and June 2011. In depth information for each of the courses listed below can be found by following the links at (AMSA - EPR Training).

The National Plan training program for 2008-2009 included the AMSA-run courses, listed in Table 19 along with the number of participants. Each state and various local authorities also hold various training courses throughout the year, information about which can be found in the National Plan's Annual Reports (AMSA, 2009).

The AMSA has educational resources and information available on their website for young children, teachers and the general public (AMSA Educational Resources). This information focuses on promoting awareness of marine pollution, the basic science behind oil-spills and how Australia deals with incidents.

Response Exercises

The National Plan calls for major oil-spill response exercises, requiring involvement from multiple agencies, once every two years at various locations. The purpose of the exercises, which began in 1996, is “to test the operational and administrative arrangements for responding effectively to a major marine oil-spill” (AMSA, 2006). The resulting reports, which include lessons learned, are available online along with similar reports for incident responses (AMSA Incident and Exercise Reports).

Table 18 - Oil-spill response Training Offered in Australia and New Zealand

Course Name	Organization	Location	Dates
Core Group Assessment Course	AMOSC	Geelong, VIC	Nov 8 - 12
Course in Oil-spill Command & Control	AMOSC	Geelong, VIC	Nov 22 - 26
Course in Oil-spill Management	AMOSC	Geelong, VIC	June 6 - 10
			July 12 - 16
			Aug 23 - 27
			Oct 11 - 15
			Feb 21 - 25
Course In Oil-spill Operations	AMOSC	Geelong, VIC	April 18 - 22
			Aug 2 - 6
			Sep 13 - 17
			Mar 21 - 25
Environmental and Scientific Coordinators (ESC) Workshop	AMSA	Bondi, NSW	May 2 - 6
Finance, Administration and Logistics course	Maritime NSW	Sydney, NSW	Aug 17 - 19
HNS Marine Spill Management Course	AMSA	Melbourne, VIC	Aug 24 - 25
Lord Howe Island oil-spill response exercise	Maritime NSW	Lord Howe Island, NSW	Oct 25 - 27
Marine Oil-spill Management & Supervisory Training Course	Maritime NZ	Auckland, NZ	July (TBA)
Marine Oil-spill Oiled Wildlife Training Course	Maritime NZ	Palmerston North, NZ	Aug 11 - 12
Marine Oil-spill On-Scene Commanders Training Course	Maritime NZ	Auckland, NZ	April 27 - 29
NSW annual maritime incident response exercise	Maritime NSW	Sydney and Port Kembla, NSW	June 13 - 17
Oil-spill response Operator Training Workshop	WA DOT	Dampier, WA	Oct 13 - 14
		Geraldton, WA	July 27 - 29
		Esperance, WA	Aug 17 - 19
Oil-spill response Shoreline assessment and cleanup training	WA DOT	Broome, WA	Nov 23 - 25
		Geraldton, WA	July 6 - 7
Regional Council Workshop 2010	Maritime NZ	Northland, NZ	Sep 21 - 22
Regional Responders Initial Training Course	Maritime NZ	Auckland, NZ	Aug 25 - 26
			Oct 11 - 14
			Nov 9 - 12
Regional Responders Revalidation Training Course	Maritime NZ	Otago, NZ	Mar 8 - 11
		Wellington, NZ	Nov 16 - 18
		Canterbury, NZ	Mar 28 - 30
		Auckland, NZ	Apr 11 - 13
			May 9 - 11

Source: Modified from (AMSA - EPR Training)

Table 19 - Courses run by AMSA for 2008-2009, as per the National Plan

Course	Location	Date	Attendees
Oil-spill Management	Melbourne	Oct 2008	22
Pilot Level 1 Chemical Spill-response Course	Sydney	Mar 2009	10
HNS Spill Management Course	Perth	Apr/May 2009	16
Oil-spill Management	Sydney	May 2009	23

Source: Modified from (AMSA, 2009)

Individual States (including the Northern Territory) also hold various exercises throughout the year, ranging from table-top exercises to local deployment and full-scale state response exercises. Information on these can be found in the National Plan's Annual Reports (AMSA, 2009).

4.5.4.4 International Cooperation and Agreements

Australia has ratified MARPOL Annexes 73/78, III, IV, V, and VI.

Australia was one of the first countries to adopt the OPRC Convention. The National Plan encompasses most of Australia's obligations as a signatory of the convention. In the event of a major oil-spill, provisions are made for the speedy entry of equipment from international stockpiles in Singapore and Southampton, U.K. and personnel from overseas.

Australia is also party to the CLC 1992, Fund 1992, Supplementary Fund, and Bunker conventions.

Regionally, Australia is part of the Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (1986). Memoranda of Understanding exist with New Zealand, New Caledonia, Papua New Guinea, Singapore and Indonesia.

4.5.4.5 Overall Commitment

In the final part of this section, the commitment of Australia to oil-spill response is discussed. Funding and preparedness improvement efforts, including research and development, are presented followed by a summary of the country's overall preparedness for spill-response.

Funding

Funding of the National Plan is based on the potential-Polluter-Pays-Principle where a levy is imposed on commercial shipping using Australian ports. There are also international conventions implemented that address the cost recovery following spill-response. Individual regional Governments, along with industry and ports also provide direct and indirect funding for the National Plan.

Improving Preparedness (Including Research and Development)

The lessons learned from major response exercises, held every two years, and any major incident responses are well documented and incorporated into the National Plan. Government response equipment stockpiles also undergo audits and updating on a regular basis.

A Research, Development and Technology program is part of the National Plan. There is continuous monitoring of advances in response techniques and technology. Before any new response measures are accepted and introduced into the National Plan they must be extensively proven in the field, be non-invasive and they must not create any additional problems.

According to the *Approval of new oil-spill response products for use in Australia Fact Sheet*, the ASMA has no statutory licensing powers and there is no “approval process” per se for new technology from independent suppliers. The AMSA encourages all National Plan agencies to consider purchasing any new types of equipment (e.g., booms, sorbents, skimmers) that may suit their needs. It is stated that Australia’s Environment Protection and Biodiversity Conservation Act and the MARPOL Convention “*do not apply where any product is used only as part of a response mounted by the relevant National Plan combat agency and in accordance with the applicable contingency plan*”. That being said, any new dispersants seeking approval from the AMSA must satisfy all health, safety and technical data requirements.

The AMSA stresses that each oil-spill is unique and is to be treated as such. This applies to the use of all oil-spill response resources, including dispersants and sorbents.

Summary of Australia’s Preparedness, Training and Commitment

Australia’s response strategy revolves around the National Plan to Combat Pollution of the Sea by Oil and Other Noxious and Hazardous Substance (the National Plan). The Australian Maritime Safety Authority (AMSA) is responsible for major response preparedness whereas the Australian Marine Oil-spill Centre (AMOSC) is the major industry organization involved.

Australia’s response policy applies both Net Environmental Benefit Analysis and the Tiered Response approach. There are national and state/territorial contingency plans in place as well as plans developed by industry and ports for smaller spills.

There is response equipment, managed by either Government or industry, at various locations around Australia. Local ports and oil-handling companies have Tier 1 response equipment whereas larger regional and national stockpiles are used for larger spills. Dispersants must meet strict guidelines before their use is allowed. Government response equipment stockpiles undergo audits and updating on a regular basis.

Both the AMSA and AMOSC offer training courses at levels ranging from oil-spill operations to upper management. These courses are offered at various times throughout the year and at various locations. State and various local authorities also hold a wide range of training courses.

Major response exercises are held every two years, the lessons learned from which are well documented and incorporated into the National Plan. Individual states also hold a wide range of response exercises throughout the year. Australia has experience responding to several major oil-spills.

Australia is party to many international conventions and agreements.

The National Plan is funded primarily on a potential-Polluter-Pays-Principle, whereas regional Governments as well as industry and ports also provide funding.

Research and development is part of the national plan but before any new response measures are accepted and introduced into the National Plan they must be extensively proven in the field, be non-invasive and they must not create any additional problems.

4.5.5 United States

The United States, like the other countries examined, manages a range of oil-spill contingency plans having equipment and personnel in various locations around the coast. Its national response strategy is the primary responsibility of the United States Coast Guard. The United States has experience dealing with various oil-spills and is party to several international conventions and agreements.

Information about the U.S.'s preparedness, training and commitment is based largely on (ITOPF U.S., 2009), (OSHA), (EPA NCP) and (SONS, 2010), among other sources.

It is important to note that due to the ongoing Macondo incident, the U.S. oil-spill response system may undergo changes and restructuring. The information provided here should be accurate up to the date any changes are implemented.

4.5.5.1 National Oil-spill Response Strategy and Policy

The national authority on oil-spill response is the United States Coast Guard (USCG), with the USCG National Response Center located in Washington DC.

Marine oil-spill response is conducted following regulations found in 40 CFR 300 (40 CFR 300), known as the National Oil and Hazardous Substance Pollution Contingency Plan (the National Contingency Plan or NCP). The NCP is the federal Government's blueprint for responding to oil-spills and its latest revisions were completed in 1994, following the *Oil Pollution Act* of 1990 (OPA '90) (EPA NCP).

The response effort usually involves a large network of Government, community and industry agencies along with private contractors. Federal or state Government agencies monitor the polluter and take over the response effort if the polluter is deemed not capable of responding adequately (OSHA).

The level of response to a spill is determined by its severity. A Federal On-scene Commander (FOSC), a State On-scene Commander and a representative from the polluter may all be involved in leading the response. An Incident Command System, composed of planning, operations, logistics and finance sections, may be established to ensure effective cooperation between all parties in the response. For major spills, a National Incident Task Force, with Governmental and private parties, would be established and commanded by a USCG appointed National Incident Commander. The USCG National Strike Force Coordination Centre advises on cleanup, with experts from NOAA, the Department of the Interior and the U.S. Army Corps of Engineers (SONS, 2010; ITOPF U.S., 2009).

There is a National Response Team (NRT), comprising 16 federal agencies with the Environmental Protection Agency as chair and the USCG as the vice-chair. There are 13 regional response teams (RRTs), one for each of the designated federal regions, which are chaired by the EPA and USCG and include federal and state staff. The NRT and RRTs have a planning, policy and coordination role and do not respond directly to incidents. They develop contingency plans and provide advice during a spill, including dispersal approval. Area Committees, which include federal, state and local agencies, maintain the local area contingency plan, which was developed by each USCG Captain of the Port Zone. The local area contingency plan includes local sensitivity maps and spill-response strategies. There are also various subcommittees involving local interested parties. All oil-handling facilities must operate a contingency plan (SONS, 2010; ITOPF U.S., 2009).

Tankers in U.S. waters are required to have a vessel response plan (VRP). This must include pre-contacted agencies capable of a response for the full range of possible spill scenarios as well as an appointed Qualified Individual and spill management team having the authority to implement the response plan. Various states have requirements for tanker operators that may differ from the federal requirements (ITOPF U.S., 2009).

The liability of the polluter is limited, according to the size of the vessel, with respect to removal costs and pollution damage. These limits are bypassed if the polluter doesn't adequately report the incident or cooperate with authorities. In some states there is no right of the polluter to limit liability. Responsibility for response is on the polluter with coordination by a designated FOSC. The polluter is expected to enact the VRP and if the response is unsatisfactory the FOSC can take over the cleanup and appoint contractors at the polluter's expense (ITOPF U.S., 2009).

Response Policy

The U.S. response policy is primarily one of containment and recovery. Several states have pre-approved sites for dispersants (based on location, not dispersant type or toxicity) and in-situ burning.

4.5.5.2 Guidelines and Regulations for Offshore Operators

The Minerals Management Service governs environmental issues related to offshore oil development. Strictly speaking, this federal agency supersedes any state requirements for developments located in waters greater than 3 miles offshore, but in environmental matters they cooperate with and take guidance from state guidelines or regulations. The three main oil-producing Regions under MMS are the Gulf of Mexico OCS, the Pacific OCS, and the Alaska OCS. General plan regulations for all Regions are discussed first, followed by region-specific guidelines.

National Guidelines

By regulation, an operator is required to submit an Oil-spill Contingency Plan to MMS for approval prior to submitting an exploration or development plan. The Plan outlines the availability of spill containment and cleanup equipment and trained personnel. The Plan must include provisions for varying degrees of response effort, depending on the severity of a spill, and must ensure the availability of the equipment and personnel necessary to respond to a worst-case discharge.

The ability to respond to a worst-case discharge, in practice, means that an operator must be a member of an oil-spill cooperative for the identified facilities. Whether part of a cooperative effort or not, the operator must certify that it has the capability to respond, to the maximum extent practicable, to a worst case discharge (Maximum extent practicable is defined as the limits of available technology, as well as the practical limits of personnel, to respond to a worst-case discharge in adverse weather). Provision is also made for periodic unannounced drills of initial emergency procedures including plan activation, reporting, call-out of resources, and initial logistics.

MMS also requires that an operator provide oil-spill trajectory analyses specific to the area of operations. As a minimum, they must provide trajectory analyses to determine the maximum distance from the facility that oil could move in 48 hours, based on a worst-case discharge and credible adverse winds and currents over a range of seasons and weather conditions.

Gulf of Mexico Region

The Gulf of Mexico is the most prolific of the three Regions in terms of oil production. It comprises more than a billion offshore acres and currently supplies a quarter of the U.S. production of natural gas and oil.

As described above, operators are required to submit a response plan to MMS Regional staff for approval. There are no specific requirements for equipment on site, or time standard for equipment arriving at a spill scene. In the words of MMS staff responsible for evaluating such plans, the plan that is submitted must “make sense” although there are no specific time and capacity standards. Dispersant use has been extensively studied for its potential benefits and environmental effects. For over ten years, dispersant use has been “pre-approved” in terms of the question of environmental effects for all federal waters of the Gulf (i.e., those greater than 3 miles offshore). In practice, consultation between the proponent and the Federal On-scene Commander would take place prior to a use of dispersants.

Pacific Region

This Region covers the entire Pacific coast of the contiguous States, but current offshore activity is limited to oil and gas leases offshore southern California, 43 of which are producing about 22 million barrels of oil and 41 billion cubic feet of gas annually.

There are no specific regulatory standards for response time and cleanup capability. There are guidelines that the MMS, United States Coast Guard, and California Coastal Commission (CCC) developed in the late 1970’s that called for the initiation of containment procedures within 1 hour of notification, and initiation of recovery within 2 hours. These guidelines have been used as benchmarks for drills, and operators in the Pacific Region have listed them in their response plans. Offshore facilities meet this time guideline in one of two ways: by stationing containment equipment directly on the platform, or through a contractual arrangement with a spill-response cooperative that can deliver equipment to the scene within the specified time. There are no pre-spill deployment requirements although sometimes, as a mitigation measure prior to new drilling operations, operators have been asked to contact their cooperative and in some cases have had a response vessel on stand-by. In the Gulf of Mexico there is pre-approval to use dispersants.

The state of California has responsibility for facilities within 3 miles of the coast, and they may impose additional requirements on a case-by-case basis. For example, to facilitate early containment of an oil-spill, the California Coastal Commission required one lease holder (for exploratory drilling in the Santa Barbara Channel) to have certain minimum oil-spill containment and cleanup equipment on drillships or at the site at all times. Specifically, this included 1 500 feet of open-ocean containment boom and a boat capable of deploying the boom, one oil-skimming device capable of open-water use, and fifteen bales of oil sorbent material.

Alaska Region

In the wake of the *Exxon Valdez* spill, more rigorous and prescriptive standards were adopted for both tanker operations and oil and gas developments. Currently, the majority of oil activity in Alaska is on State lands; offshore activity in the Beaufort Sea is just beginning to go beyond the 3-mile limit. Whereas offshore developments are in theory governed by federal statute, MMS mandates that contingency plans be consistent with State regulations.

State regulations declare that, “Operators of exploration or production facilities, or pipelines, must be able to contain, control, and cleanup the realistic maximum oil discharge within 72 hours.” The 72-hour requirement is used as a planning guideline to establish the equipment requirements (i.e., booms, skimmers, and storage containers). The “realistic maximum oil discharge” means “the maximum and most damaging oil discharge that the Alaska Department of Environmental Conservation (ADEC) estimates could occur based on the nature of the project, and ADEC’s experience with such”.

Specified contents of the contingency plan are quite detailed, listing measures for spill detection, notification, communications, and so on in addition to basic equipment requirements. As for equipment, the requirements are quite prescriptive. Current regulations require that operators be able to mechanically contain and recover, within 72 hours, a response planning standard (RPS) volume of oil. For exploration and production facilities, the RPS from an uncontrolled blowout is a minimum of 5500 barrels per day (36 m³/h). If well data indicate a higher production rate, the RPS is adjusted accordingly. In practice, this standard is not exceedingly difficult to attain; nameplate capacities for skimmers can be used with a derating factor, and there are a multitude of devices that are appropriate. In fact, ADEC has judged that the industry can meet the RPS in open-water and solid ice conditions; however, broken ice conditions present special problems. The analysis indicates that mechanical methods cannot recover sufficient quantities of spilled oil to meet the state’s required 72-hour RPS standard in broken ice conditions (S. L. Ross Environmental Research Ltd., 1998).

The only requirement for the pre-deployment of boom is a lease stipulation regarding refueling operations of 100 bbls or more between a fuel barge and drilling vessel during the bowhead whale migration in the Beaufort Sea. There was at one time a stipulation that equipment be cached at strategic location near sensitive areas, but this was abandoned when it was determined that deployment at the time of an event was faster and subjected the equipment to less damage.

Dispersant use has not been looked on favourably in Alaska for many years due to a general feeling that they would be ineffective in the cold waters present there. Years of research since the *Exxon Valdez* spill has demonstrated that Alaskan oils may be candidates for dispersion under some conditions, and a pre-

approval process has been implemented. Nonetheless, the topic remains a controversial one in Alaska and their use in practical terms remains uncertain.

4.5.5.3 Equipment

Government

The USCG has large amounts of equipment at strategic sites around the coast having various USCG vessels adapted to deploy the equipment. USCG Strike Teams are located on the three seaboard to provide specialized equipment and personnel. The USCG and National Guard both have aircraft/helicopters for equipment deployment and surveillance. All this is intended as backup for equipment from the private sector (ITOPF U.S., 2009).

The U.S. Navy has large amounts of equipment at its bases, which is intended for naval use but may be used in other cases if required. Three major stockpiles have been established by the Navy salvage division (ITOPF U.S., 2009).

Private Industry

Over 100 private oil-spill removal organizations have been classified by the USCG to work in U.S. waters (depending on the situation), of which, the Marine Spill-response Corporation and National Response Corporation operate nationwide. They have dedicated vessels deployed at various ports and have non-dedicated multi-purpose vessels. Several spill-response cooperatives operate on the west and east coasts. The oil-company-funded Clean Caribbean and Americas operates large amounts of equipment out of Florida, which is packaged for immediate aerial transport. The majority of oil ports, terminals and other oil-handling facilities also maintain spill-response equipment (ITOPF U.S., 2009).

4.5.5.4 Training

This section outlines available and required training courses offered by Government and industry as well as response exercises and experience with previous spills. The United States run a system of training suited for their own regulations and do not necessarily coincide with the courses put forward by IMO.

Courses

The Occupational Safety and Health Administration (OSHA) outlines marine oil-spill response training under the Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) as per *Title 29 of Code of Federal Regulations (CFR) 1910.120*. An emergency response is defined by CFR 1910.120 as "*a response effort... to an occurrence which results, or is likely to result, in an uncontrolled release of a hazardous substance,*" while post-emergency response is performed "*after the immediate threat of a*

release has been stabilized or eliminated and cleanup of the site has begun". All tables and appendices referred to in the figures can be found at (OSHA). Training can be completed at OSHA's Training Institute in Illinois or at one of the established OSHA Training Institute Education Centers around the country, however many centers do not offer the full range of courses.

Texas A&M's National Spill Control School (NSCS), in Corpus Christi, Texas was established in 1977 and was named as a consulting, training, and research resource of the National Response Team in OPA '90 (Texas A&M). The NSCS offers the following courses:

- Oil-spill response in Ports and Inland Waterways - this hands-on course focuses on equipment use, spill containment and recovery and response strategies (40-hour HAZPOWER course).
- Shoreline Cleanup Assessment Team - the course provides fieldwork for training in shoreline characterization and assessment of oil-spill impacts on said shorelines, using a variety of tools (40-hour course).
- GIS & GPS for Oil-spill Management - this course focuses on the technology available to construct an 'Oil-spill Management Toolkit'(16-hour course).

Texas A&M also offers 8-hour HAZPOWER refresher courses, Marine Oil-spill Supervisor courses, a 40-hour course for Military and Industrial Facilities, 24-hour OSHA courses, a 2-hour community volunteer course and various other courses related to the transportation and cleanup of hazardous materials. The courses are held at various times throughout the year and in various locations around the country (including Ohmsett, discussed below). A complete list and schedule can be found at (Texas A&M).

The Ohmsett National Oil-spill Response Research Facility, located in New Jersey, offers an Oil-spill Response and Strategies Training course. This course is designed for oil-spill management personnel. It incorporates classroom instruction, over eight hours of safety topics (as per OSHA 29 CFR 1910.120), cleaning up oil spilled in varying marine conditions, NIIMS Incident Command Systems training, table-top spill-response exercises and various other features. They also offer the 5-day USCG Oil-spill response Technician Training based on National Strike Force qualification requirements. Scheduling of courses varies and is based around use/status of the wave tank. Classes have included (Ohmsett Training):

- Texas A&M University National Spill Control School Training
- Oil-spill Strategies and Techniques Training
- USCG BootCamp/Lightering, Oil-spill Responder Training

- 40-Hour HAZWOPER
- 8-Hour Refresher
- Confined Space Entry certification training
- Dispersant Training for the Oil-spill Responder
- CHS Fast Water and River Response Training
- Alaska Clean Seas
- ChevronTexaco
- MMS ICS Exercise
- ConocoPhillips IMAT

NOAA's Office of Response and Restoration offers no-charge 3-day Science of Oil-spills workshops several times a year in Seattle and online self-study for personnel involved in oil-spill response. The workshops cover (NOAA ORR):

- fate and behaviour of oil-spilled in the environment
- an introduction to oil chemistry and toxicity
- a review of basic spill-response options for open-water and shorelines
- spill, case studies
- principles of ecological risk assessment
- a field trip
- an introduction to damage assessment techniques
- determining cleanup endpoints

NorthWestHazMatInc in Oregon, offer oil-spill response courses on a quarterly basis. Each course meets or exceeds the recommendations of OSHA 29 CFR 1910.120 and includes both classroom and hands-on training. Course topics and focus areas include (NorthWestHazMat):

- First Responder Awareness
- First Responder Operations
- HazMat Technicians

- HazMat Specialists
- Incident Commanders

Oil-spill response Ltd. only offers their Advanced Spill Management course in the U.S. It is a 3-day course offered once per year in Washington and Texas. The course is recommended for senior staff that have a responsibility for oil-spill planning, logistics and operations as part of the local management team and focuses on the initial 24 to 48 hours of a spill (OSR, 2010). A variety of other organizations around the country offer similar courses to those mentioned above.

Response Exercises

As part of the NCP and OPA '90, the USCG leads a Spill of National Significance (SONS) exercise every one to four years at different locations around the country, designed to increase national preparedness for catastrophic oil-spills. The NCP defines a SONS as *“a spill that due to its severity, size, location, actual or potential impact on the public health and welfare or the environment, or the necessary response effort, is so complex that it requires extraordinary coordination of federal, state, local, and responsible party resources to contain and clean up the discharge”*. As per (SONS, 2010) the objectives of the SONS program are:

- *“Increase national preparedness for a SONS by engaging all levels of spill management (local, regional, national and international) in a coordinated response.*
- *Improve, through practice, the ability of the National Incident Commander to integrate the response organization to manage a SONS.*
- *Ensure that senior agency officials are aware of their role during a SONS.”*

After each SONS exercise, data collected by controllers, evaluators and players are used to identify lessons learned and best practices with respect to the exercise objectives. During the recent SONS 2010 exercise, over 200 personnel from 50 agencies (including international, federal, state and industry groups and organizations) participated (SONS, 2010).

There is also the National Preparedness for Response Exercise Program (PREP) that was developed as part of OPA '90. As per (DOT et al, 2002), *“The PREP was developed to provide a mechanism for compliance with the exercise requirements, while being economically feasible for the Government and oil industry to adopt and sustain. The PREP is a unified federal effort and satisfies the exercise requirements of the Coast Guard, the Environmental Protection Agency (EPA), the Research and Special Programs Administration Office of Pipeline Safety, and the Minerals Management Service (MMS). Completion of*

the PREP exercises will satisfy all OPA 90 mandated federal oil pollution response exercise requirements.”

The goal of the PREP is to conduct 20 area exercises per year nationwide, 6 of which would be led by Government and the remaining 14 by industry. An area is defined as a geographic area for which a separate and distinct Area Contingency Plan has been prepared. Each component of the detailed response plans must be exercised at least once over three years. These components include (DOT et al 2002):

- 12 qualified individual notification exercises
- 12 emergency procedure exercises
- 3 spill-management team table-top exercises
- 3 unannounced exercises
- Various equipment deployment exercises

Offshore facilities are required to run exercises similar to those discussed above.

Previous Spill-response Experience

The United States has experienced a number of significant oil-spills. The *Argo Merchant* (1976) spilled 28 000 tonnes of No 6 fuel oil off the coast of Massachusetts, but natural conditions were favourable and there was relatively little impact. The response of the *Mega Borg* (1990), which spilled over 16 000 tonnes near Texas, involved containment, recovery and dispersant use. The *American Trader* (1990) spilled nearly 1 300 tonnes of crude oil off the coast of California and the *North Cape* (1996) spilled 2 600 tonnes of home-heating oil near Rhode Island. Both of these spills had major responses.

The *Exxon Valdez* (1989) spilled 37 000 tonnes of crude into Prince William Sound in Alaska and was followed by a major response including offshore containment and recovery and extensive beach cleanup. This spill led to the creation of OPA '90 (SONS, 2010).

In terms of offshore exploration and production, the Santa Barbara blowout in 1969 was a key event in the environmental movement in the U.S., and led to drilling moratoriums on the east and west coasts that are still in place today.

The response to the Macondo incident, which began on April 20, 2010, has employed nearly the full range of response techniques, for both sea and beach cleanups. Current estimates state that 600 000 tonnes or more of crude oil have spilled into the Gulf of Mexico, making this by far the largest oil-spill in U.S. history. This spill is leading to changes in the U.S.'s oil-spill response plans.

4.5.5.5 International Cooperation and Agreements

The United States has ratified MARPOL Annexes 73/78, III, IV and V along with OPRC, 1990.

Regional agreements exist between the U.S. and Bermuda, Canada, Japan, Mexico and the Russian Federation.

Whereas the U.S. is part of several international agreements, their recent response to the Macondo spill, which began on April 20, 2010, has shown their hesitancy for accepting international help. Three days after the spill began the Netherlands offered ships equipped to handle major spills at no charge as well as strategies and equipment to protect Louisiana's marshlands with sand barriers (that operate twice as fast as the U.S. companies who were eventually awarded the work). Both offers were refused by the U.S. Government despite BP's desire to accept. By May 5 the U.S. Government had refused offers of help from 12 other Governments, most of which have superior expertise and equipment. Part of the problem is that European recovery vessels don't meet the regulations that water must be 99.9985% pure before being returned to the Gulf of Mexico, even though they have huge capacities. Instead, the U.S. stores the recovered water and decants it to remove oil. This process requires ten times more trips to storage facilities than the Dutch ships (Solomon, 2010).

They eventually accepted Dutch help but insisted on airlifting Dutch equipment and retrofitting American ships rather than allowing Dutch ships to operate in the Gulf of Mexico. This restriction is based on *The Jones Act*, a U.S. Federal statute that regulates maritime commerce in U.S. waters and between U.S. ports. Vessels must be built and documented in the U.S. and be owned and operated by U.S. citizens. They also didn't want the experienced Dutch crews operating on American shorelines so cleanup efforts were delayed while U.S. crews were trained. The priority of the cleanup was the protection of U.S. jobs (Solomon, 2010) and was not based on a Net Environmental Benefit Analysis.

4.5.5.6 Overall Commitment

In the final part of this section, the commitment of the United States to oil-spill response is discussed. Funding and preparedness improvement, including research and development, efforts are presented followed by a summary of the country's overall preparedness for spill-response.

Funding

Funding for the MMS's Oil-spill response Research (OSRR) Program and Ohmsett (the National Oil-spill response Test Facility), discussed below, is received from the Oil-spill Liability Trust Fund (OSLTF). The OSLTF received \$1 billion from a \$0.05/barrel tax and now operates off the interest as well as cost

recovery from polluters and penalties. Once the \$1 billion mark was reached the tax was suspended and is to be reinstated if the fund ever drops below \$1 billion.

Improving Preparedness (Including Research and Development)

At the national level, major spills such as the *Exxon Valdez* have prompted changes to national response strategy. The OPA '90 was developed in response to the *Exxon Valdez* incident and, more currently, the Macondo incident is having broad reaching impacts on U.S. oil-spill preparedness.

The OSSR Program has funded oil-spill research for over 25 years. Its primary focus is “*improve the knowledge and technologies used for the detection, containment and cleanup of oil-spills that may occur on the U. S. Outer Continental Shelf.*” The OSRR Program responds to the needs of MMS’s regional and district offices and the program outputs are integrated into MMS’s offshore operations. Response technologies identified by the OSRR Program focus on preventing spills from reaching sensitive coastal environments (OSRR).

The OSRR Program is an “openly-cooperative effort” drawing funding and expertise from Government agencies, industry and the international community. Most procurements of R&D projects are competitive with contractors selected based on fulfillment of MMS requirements, technical quality and estimated costs. Results of R&D are made widely available through various journals, reports and public information documents (OSRR).

Current major OSRR projects include (OSRR):

- Remote sensing and detection
- Physical and chemical properties of crude oil
- Mechanical containment and recovery
- Chemical treating agents and dispersants
- In-situ burning
- Deepwater operations
- Operation of Ohmsett - The National Oil-spill response Test Facility

Ohmsett, located in New Jersey, is the only facility in the United States where full-scale oil-spill response equipment testing, research, and training can be conducted in a marine environment with oil under controlled environmental conditions. Ohmsett also provides oil-spill response and strategies training that involves, among other things, over 8 hours of safety topics (OSHA 29 CFR 1910.120) relative to oil-spill emergency responders (Ohmsett).

Summary of the United States' Preparedness, Training and Commitment

The United States' response strategy revolves around the National Oil and Hazardous Substance Pollution Contingency Plan. Whereas the United States Coast Guard (USCG) is the national authority in oil-spill response, there are literally dozens of other Government agencies and committees having response leadership roles at the national or regional level.

The level of response is determined by severity, but doesn't necessarily follow a Tiered Response system. All oil-handling facilities and vessels must have a contingency response plan. Various States have requirements that build upon the national requirements.

The USCG has large stockpiles of response equipment at strategic sites around the coast, as does the U.S. Navy. These stockpiles are intended as backup to equipment from the private sector. Over 100 oil-spill response contractors of various size and capability are available. The majority of oil-handling facilities have their own response equipment.

The U.S. runs a system of training designed to meet their own regulations. The Occupational Health and Safety Administration specifies the required response training and divides workers into emergency and post-emergency responders. The Texas A&M National Spill Control School offers nearly the full spectrum of required courses. There are also many other agencies (both private and Government run), including the Ohmsett National Oil-spill response Research Facility, that offer a range of courses at various locations and times.

Major national response exercises, designed to increase national preparedness for catastrophic oil-spills, are held every one to four years. After each exercise, lessons learned and good practices related to the exercise objectives are gathered from participants. The National Preparedness for Response Exercise Program requires that 20 area exercises are conducted per year nationwide and that each component of a detailed response plan must be exercised at least once every three years. Offshore facilities are required to run similar exercises.

Whereas the United States is party to several international conventions and agreements, they are not party to any compensation conventions and have a history of turning down response resources and expertise from other countries.

The Oil-spill response Research program is well funded by the Oil-spill Liability Trust Fund, a \$1 billion fund established through a small per-barrel tax. Projects include those relating to mechanical containment and recovery, in-situ burning, deepwater operations, remote sensing and detection as well as studying the properties of various oils.

4.5.6 Newfoundland and Labrador

Canada, like the other countries examined, manages a range of oil-spill contingency plans having equipment and personnel in various locations around the coast. Its national response strategy is the primary responsibility of Transport Canada and the Canadian Coast Guard. Canada has experience dealing with various oil-spills and is party to many international conventions and agreements.

Information presented about Canada's preparedness, training and commitment is based largely on (Transport Canada Response), (Canadian Coast Guard), (Transport Canada, 2006) and (ITOPF Canada, 2009), among other sources.

4.5.6.1 Response Policy

The first priority is to minimize the size of the spill by transferring oil from the damaged vessel to a suitable containment system. If a response is required, the initial actions focus on containment and recovery, if conditions permit, while dispersants and in-situ burning play a secondary role. Dispersants must be approved for use by Environment Canada, based on a Net Environmental Benefit Analysis.

Canada follows a Tiered Response system, outlined in Table 20 along with corresponding response time requirements for response organizations.

Table 20 - Tiers and Response Time Requirements

Tiers	Quantity of Oil	Response Time Requirements
Tier 1	150 tonnes	6 hours (for equipment to be deployed on-site)
Tier 2	1000 tonnes	12 hours (for equipment to be deployed on-site)
Tier 3	2500 tonnes	18 hours (for equipment to be on-site)
Tier 4	10 000 tonnes	72 hours (for equipment to be on-site)

Source: (Transport Canada 2006)

4.5.6.2 Guidelines and Regulations for Offshore Operators

Currently, the only significant offshore oil production is on the Grand Banks of Newfoundland. The Canada-Newfoundland and Labrador Offshore Petroleum Board manages the petroleum resources in the Newfoundland and Labrador offshore area on behalf of the Government of Canada and the Government of Newfoundland and Labrador. Operators must submit a contingency plan to the C-NLOPB for oil-spill response as part of the development approval process.

The applicable legislation under the Canada Oil and Gas Operations Act specifies the need for, "...contingency plans, including emergency response procedures, to mitigate the effects of any reasonably foreseeable event that might compromise safety or environmental protection...", that plans shall be

coordinated with applicable Government agencies, and that practice exercises of oil-spill countermeasures be identified and performed.

C-NLOPB has issued Environmental Protection Plan (EPP) Guidelines (2009) that specify the planning requirements with regards to potential spills. There are no specific requirements for the contents of the EPP, but recommendations are made on a comprehensive list of key areas such as Identification of potential spills and other hazards, methods that could be used to mitigate those incidents, identification of legal requirements, and incident reporting requirements.

There is no explicit regulatory requirement for any particular response measures or specific time standards. There is, however, an understanding between C-NLOPB and the various operators that a development plan will not be approved unless there is an on-site containment and recovery capability. As a result, the three main development projects (Hibernia, Terra Nova, and White Rose) each have a vessel in the vicinity of the production platform on 24-hour standby. The vessel is equipped with a side-sweep containment and recovery system such that a limited response could be implemented immediately in the event of a spill. In addition, contracts are in place for additional outside capability from spill-response cooperatives to provide both containment and recovery capability and a dispersant-based response.

In summary, the regulations and guidelines provide a goal-based rather than prescriptive approach to spill-contingency planning, with approval for spill-contingency plans done on a case-by-case basis with due regard to prevailing best practices in the industry.

4.5.6.3 Equipment

Government

The CCG maintains 12 staffed equipment depots and an additional 70 equipment depot sites, shown in Figure 26. The stored response equipment is designed to be easily transported by land, sea or air. The CCG also operates a large fleet of ships, helicopters and hovercraft. There are a total of 75 trained response personnel and marine pollution incident managers across the different regions and all regions maintain an Environmental Response Duty Officer 24 hours a day, 365 days a year. There are also four patrol aircraft, as part of the National Aerial Surveillance Program, that detect pollution violations in Canadian waters with a variety of remote sensing equipment (Canadian Coast Guard; ITOPF Canada, 2009; Transport Canada, 2006).

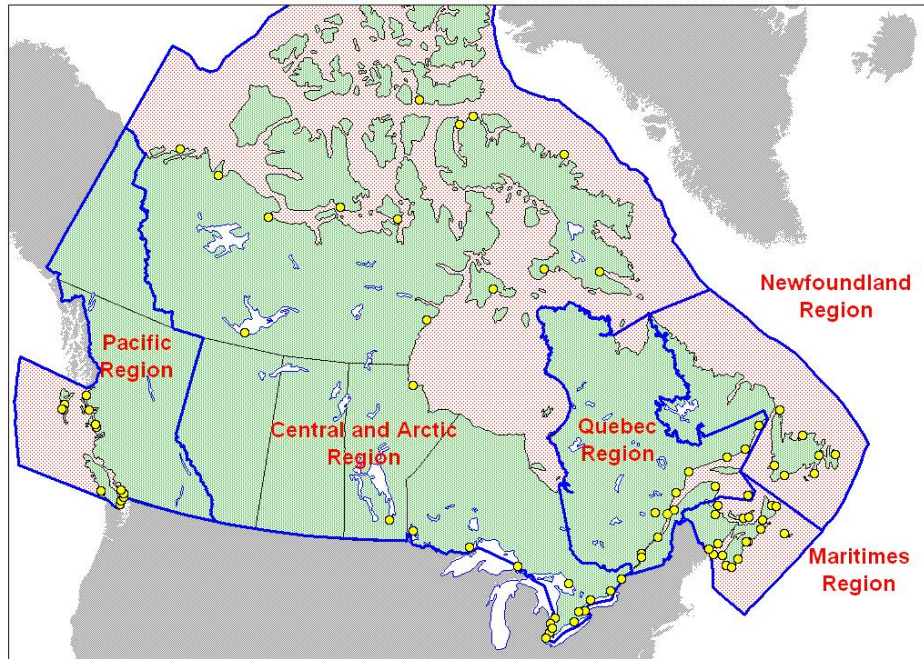


Figure 26 - Canadian Coast Guard Equipment Depot Sites

Source: Modified from (Canadian Coast Guard)

Private Industry

Both of the primary response organizations (WCMRC and ECRC) have response capabilities for oil-spills up to 10 000 tonnes. The other two response agencies (ALERT and PTMS) have response capacities of 2 500 tonnes, with the ability to call upon an additional 7 500 tonnes of capability from ECRC. Each response organization must be able to operate in environmental conditions up to and including a Beaufort Force 4 (i.e., up to a 15-knot wind), to complete on-water recovery operations within 10 days, to clean 500 metres of shoreline per day and have sufficient storage to maintain operations (ITOPF Canada, 2009).

ECRC's corporate office is in Ottawa, while it has seven response centres (Sarnia, Montreal, Quebec City, Sept Iles, Halifax, Holyrood and Come-by-Chance). Some specific ports and other oil-handling facilities have equipment capable of Tier 1 response and some have Tier 2 level equipment (ITOPF Canada, 2009).

The ECRC's Newfoundland Response Centre is located at 3 Old Placentia Road in Donovan's Industrial Park, Mount Pearl, Newfoundland. The facility consists of 5,000 square feet of office space, and 31,000 square feet of warehouse space. The Newfoundland Response Centre also maintains two sub-depots, located in Holyrood and Whiffen Head.

Table 21 provides a list of the ECRC major equipment inventory within Newfoundland and Labrador. Additional information on the ECRC can be found in Appendix XI.

Table 21 - ECRC Major Equipment Inventory within Newfoundland and Labrador

Category	Name	Number	Description
Vessels	Sea Trucks	6	10.9 meters x 3.7 meters, high speed (34 knots/hour) recovery landing craft equipped with two 200 Hp outboards, radar, depth sounder, DSC radio, loud hailer, chart plotter and mounted on a galvanized fifth wheel trailer. Three sea trucks are equipped with knuckle cranes.
	Work Boats	4	6.7m Outrage Boston Whalers with two 90 Hp outboard motors. These vessels are equipped with DSC radios, radar and chart plotters, tow and crash bars, and various length of rope c/w eyes and “G” connectors. These boats can travel at 35 knots/hour. Each boat is mounted on its own trailer with a 2” ball hitch.
		1	Aluminum 4.8 meter flat bottom workboats equipped with 45 Hp motors.
	Rigid Hull Inflatables	2	Zodiac rigid hull 5.3 meter inflatables, with centre console and tow post. Vessels are equipped with 45 Hp motors and are mounted on their own trailer with a 2” ball hitch.
		2	Zodiac 5.4 meter inflatable with centre console and tow post. Vessels are equipped with two 75 Hp motors and mounted on their own trailer with a 2” ball hitch.
		1	Zodiac 4.8 meter inflatable with one 45 Hp motor mounted on its own trailer with 2” ball hitch.
	Marsh Boats	2	3.6 meter unmotorized shoreline cleanup boats
Storage	Barges	1	1900 m ³ capacity steel single skin 8 compartment complete modified for deployment of containment and recovery equipment
		6	50 m ³ aluminum 11.8 meters x 3.7 meters x 1.8 meter storage barges mounted on their own fifth wheel trailer. Barges can be easily towed or pushed by the seatrucks. Barges have safety railing to provide a stable working area. Barges are equipped with internal piping.
	Portable	1	500 m ³ inflatable floating Unitor bag. Bag is 37.5 meters long and 8.7 meters wide when deployed. This bag is folded and stored in metal shipping container complete with all the attachments required for deployment. Bag can be towed while filling to support a skimming operation.
		1	100 m ³ inflatable Lancer barge complete with cover. Barge is folded and stored in an aluminum box for easy transport when required.
		2	25m ³ ro-tanks, folded and stored on pallets for easy transportation.
		9	Portatanks with 3.8 m ³ capacity
		8	Fabric Bags with 2 m ³ capacity
Boom	Zoom Boom	1097 metres	Self-inflating zoom boom is stored in the warehouse on racks each holding 91.5 meters. Racks are lifted by forklift for shipment on trailers or trucks. Each boom section is approximately 30.5 meters in length and sections are joined by ASTM connectors.
	Inshore Boom	4975	Log style floatation boom with chain ballast. Stored in various

	– 24”	metres	amounts on trailers and in containers at the three Newfoundland Depots.
	Inshore Boom – 36”	3950 metres	Log style floatation boom with chain ballast. Stored in various amounts on trailers and in containers at the three Newfoundland Depots.
	Inflatable Shore Seal Boom	60 metres	Overall height is 1.4 meters before inflation. Operational height is 1.16 meters. Section length is 15.2 meters and sections are joined together with ASTM connectors.
	Nofi 600 V-Sweep	155 metres	45 meter V-Sweep with braided nylon netting attached to the bottom. As the name implies, this boom forms a “V” shape at the base for oil collection and comes with 110 meter guide boom.
	Nofi 1000 Advancing V-Sweep	370 metres	97 meter V-Sweep with braided nylon netting attached to the bottom. As the name implies, this boom forms a “V” shape at the base for oil collection and comes with a 273 meter guide boom.
	Ro Boom 1500	250 metres	Boom on powered reel and comes with two inflators and trailer
	Mini Bow Sweeps	2	Used in conjunction with our seatrucks, Ro-clean 1830 and Oilstop auto boom 13m with rigging and sweep arms.
	Oil Stop Deep Sea	250 metres	Boom on powered reel and comes with two inflators and trailer
Skimmers	Lori Brush	1	This skimmer is a four brush system (two on each side) mounted on a landing craft. The rated recovery is up to 164 m ³ /hour and comes complete with power pack, two storage tanks (2.5m ³ aluminum tanks) and transfer pump.
	Axiom Belt Skimmer	1	This belt skimmer is designed for the recovery of heavy oils. It is typically mounted on a seatruck and used as an integral part of a mobile skimming system.
	GT-260	2	Rated recover of 100 m ³ /hour. These units come with their own power pack, remote stand, discharge hoses and hydraulic hoses. The GT-260’s are hopper weir skimmers and an archimedian screw pump.
	GT-185	3	Rated recovery of 45 m ³ /hour. These units come with their own power pack, remote stand, discharge hoses and hydraulic hoses. The GT-185’s are hopper weir skimmers and an archimedian screw pump.
	MI-30	3	Oleophilic disc skimmers with a rated recovery of 30 m ³ /hour. Units come complete with their own power units and hydraulic hoses.
	Elastic Drum	1	This is an oleophilic drum skimmer with a rated recovery of 13 m ³ /hour. This skimmer come complete with its own remote power unit and hydraulic hoses.
	10CM Oil Mop	2	These units are long continuous loops of oleophilic material attached to a rope which floats on the water. A roller/wringer electric mechanism pulls the mop through the water. Rated recovery is 0.5 m ³ /hour.
	Slurp Skimmer/Manta Ray	13	Vacuum type recovery for shorelines 5 m ³ /hour
	Spill Vacuum	1	Barrel mounted venturi vacuum with 2.5 m ³ /hour.

Platforms	n/a	2	6 x 3 meter aluminum work platforms which can be hooked together. These units can be used for skimming operations or beach flooding.
Pumps	Gorman Rupp	1	7.5 cm, self-priming, gas operated pump. This pump operates Spill Vacuum Unit and comes with suction and discharge hose.
	Honda WT40X	2	10 cm, gas operated, trash pumps with a 2300 liters/minute discharge use with water only.
	Diesel Driven	5	Diesel driven. Can be used for water and for petroleum products.
	Honda WB20T	11	5 cm, gas driven pump with a capacity of 500 liters/minute. For water use only.
	Framo TK6	2	Hydraulic Driven Transfer Pump, submersible 6" discharge for medium viscosity product. Requires hydraulic power unit.
	Framo TK5	2	Hydraulic driven transfer pump, submersible 6" discharge for high viscosity product. Requires hydraulic power unit.
	Desmi DOP250	1	Hydraulic driven transfer pump, submersible low viscosity product complete with dedicated hydraulic power unit.
	Peristaltic Pump	2	Hydraulic driven transfer pump, submersible low viscosity product complete with dedicated hydraulic power unit.
Hydraulic Power Units	Power Pack	21	Diesel drive motor, which supplies hydraulic power to operate various pumps and skimmers
Air Blowers	Gas Air Blowers	9	Mixed gas driven. Units come complete with blower tube and connector.
	Yanmar Diesel	1	Cart type, rated flow of 1053 m ³ /hour, comes complete with own blower hose.
Emergency Lighting	Halogen Portable Light Stands	10	Emergency lights complete with cords.
Incinerators	Energetex	1	5 m ³ capacity with diesel driven air blower
	Smart Ash Burner	2	Barrel top incinerator that uses 120 volt, 15 amp power supply.
Portable Generators	Honda EM5000	2	Gas driven, 100-120 volt generator with an operational capacity of 4.5 hours.
	Honda EM2500K	4	Gas driven, 100 volt, operational capacity of 5.4 hours.
	Winco HPM6000	1	Gas driven, 100-120 volt, operational capacity of 5.2 hours.
	Onan	1	Diesel driven, 7000 watt, 110-120 volt, on ECRC 200
Shoreline Cleanup Trailer	13.7 meter aluminum fifth wheel trailer complete with hot or cold high/low pressure washer, electric toilet, Smart Ash Burner, furnace, four tents, 6500 watt generator, portable lighting, sorbents (pads, rolls, boom) safety clothing, 4.3 meter flat bottom aluminum boat, and various other tools to support a 25 person operation. This unit also contains 25 helicopter lift bags and a temporary electrical hook-up if required. A 25 person first aid kit and stretch is on board for medical emergencies.		
Field Operations Centre	9.4 meters self-contained Citation fifth wheel trailer. This unit is equipped with fax, cellular and satellite phone, white boards, repeater, generator, photocopier, and is hauled by a pick up truck with a fifth wheel hook up. This unit has a 11.9 meter extendible mast for radio communications.		
Communications	800 Mhz System	23	Handheld radios
		4	Mobile radios
		2	Repeaters (one stationed in the Field Operations Centre)

	VHF System	4	Base stations (one in the Field Operations Centre)
		9	Hand held radios
		13	Mobile radios
		2	Repeaters
	Other	9	Cellular phones (one in the Field Operations Centre)
		1	Satellite phone (Field Operations Centre)
		7	Pagers
Vehicles	Forklift	1	Cat 13000 lb capacity, two-stage forklift complete with barrel clasp.
	Tractor	1	Ford 8000 fifth wheel tractor
	Trucks	2	Heavy duty
		1	Light duty
Buoys, Paravanes, Anchors	<p>Newfoundland Response Depots carry a quantity of the following boom accessories in sufficient supply to deploy 100% of its boom inventory. This equipment includes the following:</p> <ul style="list-style-type: none"> • Dock slider attachments and buoys • Pennant buoys c/w quick release hooks • Anchor buoys c/w quick release hooks • Paravanes c/w tow bridles • Anchors; combination of grapnel and danforth type anchors are carried for various ocean floor conditions 		
Pressure Washers	n/a	1	Karcher, 2400 psi, gas
		1	Karcher, 3500 psi, gas
		1	Karcher, 3500 DH, diesel
Sorbents	<p>A quantity of oil absorbent is stored in the warehouse. These come in different forms such as pads, rolls, sweeps, booms and spill kits (205 litre drums). We have a variety of suppliers such as SPC, Oil Dry, Oil Wik, 3M, and Matasorb.</p> <p>The following is a summary of sorbent material by supplier:</p>		
	Pads (Bundles)	25	SPC100
	Oil Snare	90	Package of 30
	Boom (Bundles)	60	8" x 40'
	Blanket (Rolls)	23	3M HP100
Bird Hazing Equipment	<p>A quantity various bird hazing equipment and associated consumables maintained in ECRC inventory. Devises all use sound as deterrent mechanism.</p>		
	Breco Buoy	1	130 dB (max), 23.5 min blast cycles 10-12 sounds/cycle
		1	Phoenix Whaler, 119dB (max), 0.5-32 min sound cycles, 16-64 sound cycles
		3	Propane Cannons, 24 hour on/off programmable, 4 blast cycle settings
		6	Bird Hazing kits, includes pistols, 6 mm blanks, firecrackers, and whistlers
Safety Clothing and Equipment	<p>An assortment of rain gear, rubber boots (summer and winter), coveralls, gloves, goggles, safety glasses, life vests, floater suits, hard hats c/w liners, and ear protection are kept in inventory. This is in addition to the above clothing issued to contractor response personnel.</p>		
Rope	<p>A large quantity of poly and nylon rope from 3/8" to 1/2" is kept on hand. This rope is in various lengths from 20 feet to 150 feet c/w thimble eyes and "G" connectors. This is in addition to the rope stored on workboats.</p>		

4.5.6.4 Training

This section outlines available and required training courses offered by Government and industry as well as response exercises and experience with previous spills.

Courses

The CCG's Environmental Response training program consists of a progression of seven separate courses, as well as refresher training and response exercises. The courses offered by the CCG include the following (Canadian Coast Guard):

- Basics of Oil-spill response Course (BOSRC) - designed for those who take part in the physical response work. This 4-day course consists of classroom and on-the-water training and includes a written test.
- Marine Spill-response Operations Course (MSROC) - designed for OSCs of small spills who are responsible for managing cleanup, recovery and restoration operations. This 5-day course is primarily classroom-based and includes case-studies and a simulation exercise. The BOSRC is a prerequisite.
- Response Management System Course - is currently under development.
- On-scene Commanders Course (OSCC) - designed for OSCs of moderate to major spills. This 5-day course builds on the MSROC course, which is a prerequisite, and exposes participants to a variety of issues that may arise during a response.
- Pollution Prevention Officer Course - intended only for CCG and other Government agencies tasked with the duties that fall under Section 662 of the *Canada Shipping Act* and Section 15 of the *Arctic Waters Pollution Prevention Act*.
- Marine Oil-spill Shoreline Worker's Safety Course - designed for any member of the marine spill-response community who may be involved in shoreline cleanups. This 4-hour video-based course teaches safe practices when working at a spill site and requires a written/oral test.
- Exercise Planning, Conduct and Evaluation Course - designed for members of the National Marine Spill-response Exercise Program. This 3-day course covers the planning, execution and evaluation of oil-spill response exercises.

As per (CCG College), the Rescue, Safety, and Environmental Response training department at the CCG College in Nova Scotia is the national training organization responsible for delivering Environmental

Response training to the CCG and industry partners. Whereas the Environmental Response Training curriculum is presently under review, the College still offers the MSROC and OSCC.

From 2004 to 2006, WCMRC provided a total of 247 training sessions (from roughly 23 certification and non-certification courses) involving 1630 participants. In 2005, ECRC provided 254 training days (from a selection of 15 different training courses) to a total of 540 participants and in 2006 they provided 248 training days to a total of 600 participants. In 2005 and 2006, ALERT provided 25 training sessions (from a selection of 10 courses) to a total of 212 participants. PTMS provided 40 training sessions (from 17 different courses) to 417 participants between 2004 and 2006 (Transport Canada, 2006).

Response Exercises

The CCG operates the National Marine Spill-response Exercise Program (NEP) that provides principles, guidelines and planning tools to help develop cost-effective and realistic exercises. The NEP was developed in cooperation with industry, other Governmental organizations and non-Governmental organizations and provides a “*consistent approach for planning, conducting and evaluating exercises, and allows members to share efforts and reduce costs.*” Pursuant to the *Canada Shipping Act* such exercises are mandatory and should include participation from vessels, oil-handling facilities, response organizations and the CCG. The CCG holds annual response exercises (Canadian Coast Guard).

Cooperatively developed international exercises are also required on a regular basis (typically every year or two), according to their respective contingency plans.

From 2004 to 2006, the WCMRC participated in 63 training exercises, including 22 notification exercises, 23 table-top exercises, and 19 equipment deployment exercises. In 2005, the ECRC participated in 84 training exercises, 34 of which were internal exercises and 50 were external exercises undertaken with other organizations, while in 2006 they participated in 63 exercises, 34 of which were internal and 29 were external. In 2005, ALERT participated in 2 table-top exercises, 1 operational exercise and 4 notification exercises, while in 2006 they participated in 1 table-top exercise, 1 operational exercise, 1 operational ALERT/CCG exercise and 4 notification exercises. From 2004 to 2006, PTMS participated in 16 various exercises with a total of 387 personnel (Transport Canada, 2006).

Previous Oil-spill response Experience

The *Nestucca* (1988) spilled approximately 800 tonnes of bunker C oil near Washington State. Cleanup was hampered by weather conditions and the remoteness of many of the oiled shores, including Vancouver Island. The *Rio Orinoco* (1990) spilled approximately 175 tonnes of intermediate fuel oil near Anticosti, resulting in 10 kilometres of coast being heavily oiled. Again, environmental conditions delayed cleanup operations (ITOPF Canada, 2009).

Table 22 shows the total number and size of hydrocarbon spills that have occurred offshore Newfoundland and Labrador between 1997 and 2010, not including synthetic-based drilling fluid. The vast majority of the volume can be accounted for by the Terra Nova spill in 2004, which was approximately 170 000 litres (144.5 tonnes). Aside from that spill, the average spill size for the other 372 incidents was less than 30 litres.

Table 22 - Total Amounts and Number of Oil-spills Offshore Newfoundland, 1997-2010

Activity	Total Spills > 1L, 1997-2007		
	Number of Incidents	Volume (L)	Approx. Mass* (tonnes)
Exploration Drilling	42	5534.54	4.7
Development Drilling and Production	331	175546.49	149.2
Total	373	181081.03	153.9
*Assuming an average density of 0.85 kg/L			

Source: (C-NLOPB Spill Statistics)

From 2004 to 2006 the four response organizations had to respond to just over 100 Tier 1 spills (Transport Canada, 2006).

4.5.6.5 International Cooperation and Agreements

Canada has ratified MARPOL Annexes 73/78 and III as well as OPRC, 1990. Canada is also party to the CLC 1992, Fund 1992, Supplementary Fund, and Bunker conventions. In addition, Canada has its own national *Ship-source Oil Pollution Fund*, which is intended to pay claims regarding oil-spills of all types from ships of all classes.

Regionally, a formal Canada-US Joint Marine Pollution Contingency Plan has been established. Canada also has bilateral agreements with Denmark, for waters bordering Greenland, and France, for the St. Pierre and Miquelon region.

4.5.6.6 Overall Commitment

In the final part of this section the overall commitment of Canada to oil-spill response is discussed. Funding and preparedness improvement efforts, including research and development, are presented followed by a summary of the country's overall preparedness for spill-response.

Funding

Whereas the Response Regime and the response organizations are industry funded, the Federal Government funds both TC and CCG. The total budget allocation of the CCG for 2009-2010 is just over \$680 million (CCG Business Plan).

The Response Regime is based on the potential-polluter-pay-principle. Vessels and oil-handling facilities are required to pay an annual fee to the response organizations in order to maintain an adequate level of preparedness (Transport Canada Response).

Currently there is a \$40 million polluter liability limit for offshore oil-spills in the Canadian Arctic and \$30 million limit on the east coast, where Canada's only existing offshore oil rigs are operating (Mayeda, 2010).

Improving Preparedness (Including Research and Development)

In 2006, the National Advisory Council, which has a mandate to ensure Canada is prepared to respond to a major oil-spill, established six Regional Advisory Councils across Canada. These councils meet regularly to review issues of preparedness and response.

There are six Regional Advisory Councils required to represent communities and interests that could be affected by oil-spills. They have a role as a mechanism for ensuring public accountability and a mandate to make recommendations on the full range of policy issues affecting regional preparedness and response and to promote public awareness and understanding of issues and measures with respect to preparedness (Transport Canada, 2006).

The CCG's research and development program "*encourages the development of new cleanup technologies, seeks realistic and practical solutions to operational response problems, and supports equipment testing and evaluation.*" The CCG collaborates with the Provinces, private sector, universities, other Government departments and other countries and international organizations in order to avoid the duplication of efforts (Canadian Coast Guard).

The two main areas of R&D are the development of new response strategies and equipment testing and evaluation. Development of new response strategies has included projects such as testing the safety of in-situ burning (Newfoundland Offshore Burn Experiment), as well as exploring effective response measures for heavy oils such as Orimulsion© and bunker C oil. Equipment testing and evaluation is an ongoing effort to perform evaluations on promising new response equipment. This is done in order to appropriately update technologically outdated equipment and in certain cases the CCG has developed products for application in the marine industry (e.g., Portable Heavy Oil Belt Skimmer and Offshore Jib Arm Assembly) (Canadian Coast Guard).

Summary of Canada's Preparedness, Training and Commitment

Canada's response strategy revolves around the Marine Oil Preparedness and Response Regime (Response Regime). Transport Canada (TC) is the lead regulatory body and the Canadian Coast Guard

(CCG) is responsible for the operational side. There are four industry-response organizations that respond to marine oil-spills on their member's behalf.

Canada's response policy employs the Tiered Response system with specific minimum response times designated for each Tier as well as a Net Environmental Benefit Analysis, particularly for the use of dispersants. Certain vessels and oil-handling facilities must have oil-spill contingency plans in place as well as an agreement with one of the certified response organizations. Preparedness for a response to a marine spill up to 10 000 tonnes must be maintained countrywide.

The CCG maintains response personnel at 12 depots around the country and there are an additional 70 equipment depots, without full-time personnel. The CCG has a wide range of ships and helicopters and there are four dedicated surveillance and monitoring aircraft available. The response organizations have a large amount of equipment, based on their respective needs, and more equipment can be called upon from the CCG if required. Certain ports and oil-handling facilities have equipment capable of Tier 1 response and some have Tier 2 level equipment.

The CCG offers seven courses, ranging from basic response training to an On-scene Commanders course, to its staff and industry partners from the CCG College in Nova Scotia. Each response organization holds a wide variety of courses at various times and locations.

There are major international response exercises held every couple of years as well as the CCG's annual response exercises. The response organizations are required to hold a number of exercises throughout the year, ranging from table-top to full deployment and collaboration exercises. Canada and its response agencies have dealt with a large number of minor spills and have some experience dealing with major marine oil-spills.

Canada is party to many international conventions and agreements.

Whereas the Response Regime is funded and managed by industry, the CCG and TC are both Government agencies. The Response Regime is based on the potential-polluter-pay-principle and vessels and oil-handling facilities are required to pay an annual fee to their respective response organizations in order to maintain effective response capabilities.

Six Regional Advisory Councils that represent communities and interests that could be affected by an oil-spill have a mandate to make recommendations on the full range of policy issues affecting regional preparedness. TC is currently undertaking the Environmental Oil-spill Risk Assessment Project and intends to use the results to adjust the Response Regime and enhance existing programs to minimize the risk of oil-spills, where appropriate. The CCG has an R&D program with a focus on the development of new response strategies as well as equipment testing and evaluation.

4.5.7 Summary of Canadian Response Regime Verses Other Jurisdictions

This section describes the approach to spill-response in Canada and four other similar jurisdictions - Norway, the United Kingdom, Australia, and the United States - in terms of overall response strategy and policy, regulations and guidelines pertaining to offshore activities, overall response equipment inventories, training, previous spill experience, and funding. The following summarizes the major similarities and differences.

4.5.7.1 National Oil-spill response Strategy and Policy

All of the countries described have a similar overall approach to spill-response in that the party responsible for the spill is expected to lead the spill-response, with a national Government authority prepared to step in if the polluter is unwilling or unable to respond effectively. All five countries use some form of a tiered response structure, with appropriate assignments of responsibility depending on the seriousness of the incident.

In all countries except the United Kingdom, there is an antipathy toward the use of dispersants, and a strong preference for the use of containment and recovery as the primary technique.

4.5.7.2 Guidelines and Regulations for Offshore Operators

In terms of spill-response, all five countries have, for the most part goal-oriented rather than prescriptive regulations for spill-response. The exception is the United States, where federal guidelines contain specific guidance on the contents of the spill-response plan, and provide specific mathematical formula for determining the equipment required for various spill sizes, including the requirement to address a “worst-case” discharge. As well, in the United Kingdom, there are specific time standards relating to the rapid mobilization of surveillance and dispersant application equipment.

Contingency plans are evaluated by the applicable regulator with consideration of the potential spill scenarios, the level of risk that they pose, and the infrastructure available to support a response.

4.5.7.3 Equipment

Perhaps reflecting the mature nature of their offshore oil and gas industry and concomitant marine infrastructure compared with that of Canada, as well as a clear commitment to environmental stewardship, Norway is far and away the leader in this category with a robust offshore response network and a commitment to improvement through testing and research and development.

4.5.7.4 Training

Each of the five countries has somewhat of a structured training program on offer. The Norwegian response organization, NOFO, has what appears to be the most rigorous commitment to training and exercising, having monthly field exercises, monthly table-top exercises, and two to four full-scale exercises involving all partners per year. Similarly, in the other four countries listed, the national authority mandates a schedule for training and exercising of key personnel on a regular basis, varying from one to four years.

4.5.7.5 Previous Oil-spill Response Experience

In each of the countries described, significant spills in their respective histories have played a large role in the regulatory structure and response policy. Several notable examples include: the Ekofisk blowout (Norway, 1977, 15 000 m³), the largest blowout in North Sea history; the Santa Barbara blowout (United States, 1969, 15 000 m³); the *Exxon Valdez* tanker-spill (United States, 1989, 40 000 m³); the *Torrey Canyon* tanker-spill (United Kingdom, 1969, 100 000 m³); and the Piper Alpha rig explosion and fire (United Kingdom, 1988, loss of 165 lives). By comparison, the largest spill in Canadian history, the *Arrow*, occurred in 1970 and involved 8 000 m³.

4.5.8 Marine Well Containment

Chevron, ConocoPhillips, ExxonMobil, and Shell have initiated the development of a new, rapid containment response system that will be designed to fully contain the flow of oil in the event of a subsea blowout. It will be designed to address a variety of scenarios in the Gulf of Mexico, with the ability to operate in deepwater (i.e., depths up to 10,000 feet), with a containment capability of 100,000 barrels per day, and with a subsea dispersant injection system. The partners have initially invested \$1 billion for the engineering and construction of specially designed equipment with additional costs expected for operation, maintenance and contracts for existing equipment and vessels. The system will be designed such that it can be expanded and adapted for new technologies.

The system will be maintained by the Marine Well Containment Company (MWCC), a non-profit organization, that will provide fully trained crews to operate equipment, ensure the equipment is operational and ready for rapid response, and update the system capabilities as deepwater technology evolves. Participation in the MWCC will be open to all companies that operate in U.S. GOM blocks, with members responsible for pro rata share of development and operating costs. MWCC equipment and services will be accessible to Members and Non-Members under standard service contracts, with fees based on the user's contribution to the system development. Although there is no mention of its use by operators outside of the Gulf of Mexico, it is hard to imagine that it would not be pressed into service in

response to a blowout anywhere in the world given the likely political, public, and media pressures to do so in the event of a blowout.

Section 5 - Canadian Compensation Regime for Oil-spill Damage

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5.0 Canadian Compensation Regime for Oil-spill Damage

This section first discusses the potential cost of cleanup for large spills on a historical basis, and then summarizes the methods for compensation and liability limits in place for E&P operators in Canada. It is important to note that, in Canada as in most parts of the world, there are two completely separate regimes for the governance of exploration and production operations versus those of vessel-related spills. There are two distinct regimes before a spill, during a spill, and after a spill. There are two regimes for governance. These are discussed in turn, the latter being of significance due to the use of tankers to shuttle oil from offshore production locations to a trans-shipment terminal in Placentia Bay.

5.1 Response Costs

An accurate estimation of the response costs for a blowout from a well on the Grand Banks is beyond the scope and time limitations of this project. However, there have been a number of studies aimed at estimating the cost of large oil-spills. For example, COGLA, 1985 assessed the costs of 100 significant spills and attempted to make correlations between cost and various parameters such as level of preparedness, intensity of cleanup, and amount of shoreline oiled. Other studies such as Etkin, 2005, 2010, and API, 2010 attempted to calculate a “dollar-per-barrels spilled” for various types of spills for the purpose of estimating the value of different preventive measures. However, the main database for the work was small inland spills, and it is unlikely that the results could be applied, with any expectation of accuracy, to large spills in the offshore. Finally, as part of the Beaufort Sea Steering Committee series of studies in the late 1980’s, Task Group 1 attempted to estimate the costs of responding to a well blowout in the Beaufort Sea for the purpose of determining an appropriate surety to be posted by the well operator. The study brought together logistics experts from the major Arctic operators at the time, and through a series of workshops they estimated the time and equipment requirements, and corresponding costs for responding to what was defined as a “worst-case” subsea blowout in the Beaufort Sea, specifically 10 000 barrels/day for a period of 45 days. An important caveat to this work was the stipulation that the response be proportionate to the existing infrastructure in the Canadian Arctic. (Note: at that time, three companies were involved in a multi-year exploration program that included summer- and winter-time drilling, and there was a significant marine infrastructure in place.) This scenario-based approach concluded that the cost to respond to the specified blowout would be on the order of \$449 million dollars (1991 dollars, exclusive of well-control costs). Simply adjusting this for inflation would put it on the order of \$628 million in 2010 dollars.

Looking at costs incurred in responding to actual spills is somewhat problematic in that there have been so few large spills related to E&P activities in recent years. There have been several tanker-spills, and

these are generally well-documented in terms of spill-response costs given the cost-recovery mechanisms contained in various compensation funds. A recent paper describing the activities of the 1992 International Oil Pollution Compensation (IOPC) Fund documents the costs of various spills in recent years. The Table below is extracted from their report (Della Mea, 2010), but includes only those in developed countries; spills in less-developed countries have unit manpower costs that are much lower than in Canada, and may also have lower cleanup standards.

Table 23 - Costs of Several Notable Spills in Recent History

Incident	Location	Year	Spill volume, tonnes	Payments to claimants, US \$ million¹	Payments 2010 CDN \$ million²
Sea Empress	U.K.	1996	73 000	47	80
Nakhodka	Japan	1997	6 200	167	297
Erika	France	1999	20 000	138	258
Prestige	Spain, France, Portugal	2002	64 000	133	244
Includes only response costs that were reimbursed; other sources report total response costs as much as 50% greater. Amount in US dollars converted to Canadian at exchange rate prevailing at time of incident, and brought forward to 2010 using Canadian CPI data.					

These costs pale in comparison to the two highest profile events in U.S. waters, the *Exxon Valdez* incident in Alaska in 1989, which had reported cleanup costs on the order of \$2B and a similar amount in terms of damage claims, and the recent Macondo incident in the Gulf of Mexico, which had estimated cleanup costs on the order of \$9B, and may have damage claims of triple that amount. Except for the Macondo incident, all of the others described here were tanker accidents. One obvious difference with the response to the Macondo blowout has been the expense related to source control. Whereas there are costs related to salvage in most tanker incidents, none of them had the same level of vessel commitment, in numbers or time, as in the attempts to contain oil at the wellhead and drill two independent relief-wells, as has been the case in the Macondo incident. For example, each of the two relief-wells is likely to cost on the order of \$100M to complete.

On the other hand, response costs for the Montara blowout (Australia, 2009) were reported to be on the order of \$5.3 million for cleanup, and \$170 million total including well-control. The Montara well was uncontrolled for 74 days; reports on the total spill volume were not published in the official inquiry documents, and varied widely in other sources between 30 000 and 150 000 barrels. The relatively low costs for this incident can likely be attributed to: the oil was highly dispersible and the main spill-response was dispersant application, the fact that there were very limited shoreline effects attributed to the spill.

Whereas it is not possible to make a definitive estimate of response costs for the Newfoundland situation, given the many variables involved and the wide disparity in response costs noted above, some general comments can be made about the above data with regards to a comparison with potential Newfoundland spills:

- The three tanker-spills having the high costs all involved a highly persistent fuel oil, very little of which dispersed, and beached in areas of high human-use, requiring intensive cleanup. By comparison, the Sea Empress incident involved a relatively light crude oil, and dispersants were used to mitigate the effects of the spill.
- Similarly, the *Exxon Valdez* spill involved oil that quickly emulsified when a storm blew through the area on the third day of the event. The oil was very persistent, and much of it ended up beached in very high concentrations.
- By comparison, spills from Grand Banks or Labrador locations are unlikely to have the same effects on shorelines and concomitant response efforts and costs. The same cannot be said for spills emanating from locations south and west of Newfoundland.

5.2 Compensation for Ship-source Spills

Spills resulting from tankers or other vessels are addressed by several funding conventions that, in aggregate, provide up to \$537M for oil-pollution damages and cleanup costs. The Ship-source Oil Pollution Fund is Canadian, whereas two others, the Civil Liability Convention and the IOPC Funds are international.

5.2.1 Ship-source Oil-pollution Fund

The Ship-source Oil-pollution Fund (SOPF) is a special account established in the accounts of Canada. It came into force on April 24, 1989, by amendments to the *Canada Shipping Act*. The SOPF succeeded the Maritime Pollution Claims Fund (MPCF), which had existed since 1973. Effective August 8, 2001, the SOPF is governed by Part 6 of the *Marine Liability Act* (MLA) Statutes of Canada, 2001, chapter 6.

The source of the funds was initially a levy of 15 cents per tonne on oil shipments, and was imposed from 1972 until 1976; during that period a total of \$35M was collected from 65 contributors. Payers into the MPCF included oil companies, power-generating authorities, pulp and paper manufacturers, chemical plants and other heavy industries. Although no levy has been imposed since 1976, it is indexed annually to the consumer price index, and in the fiscal year April 1, 2007, the Minister of Transport had the statutory power to impose a levy of 44.85 cents per metric tonne. With interest, the SOPF now stands at approximately \$150M, which represents the maximum liability of the fund for all claims from one oil-spill.

The SOPF is liable to pay claims for oil pollution damage or anticipated damage at any place in Canada, or in Canadian waters including the exclusive economic zone of Canada, caused by the discharge of oil from a ship. The SOPF is intended to pay claims regarding oil-spills from all classes of ships and is not limited to sea-going tankers or persistent oil, as is the 1992 International Oil Pollution Compensation Fund (IOPC).

The SOPF is also intended to be available to provide additional compensation (a third layer) in the event that funds under the 1992 Civil Liability Convention (CLC) and the 1992 IOPC Fund Convention, with respect to spills in Canada from oil-tankers, are insufficient to meet all established claims for compensation. The current limits of liability and compensation for oil tanker-spills in Canada is shown in Figure 27.

The classes of claims for which the SOPF may be liable include the following:

- Claims for oil pollution damage;
- Claims for costs and expenses of oil-spill clean-up including the cost of preventive measures; and

- Claims for oil pollution damage and clean-up costs where the identity of the ship that caused the discharge cannot be established (mystery spills).

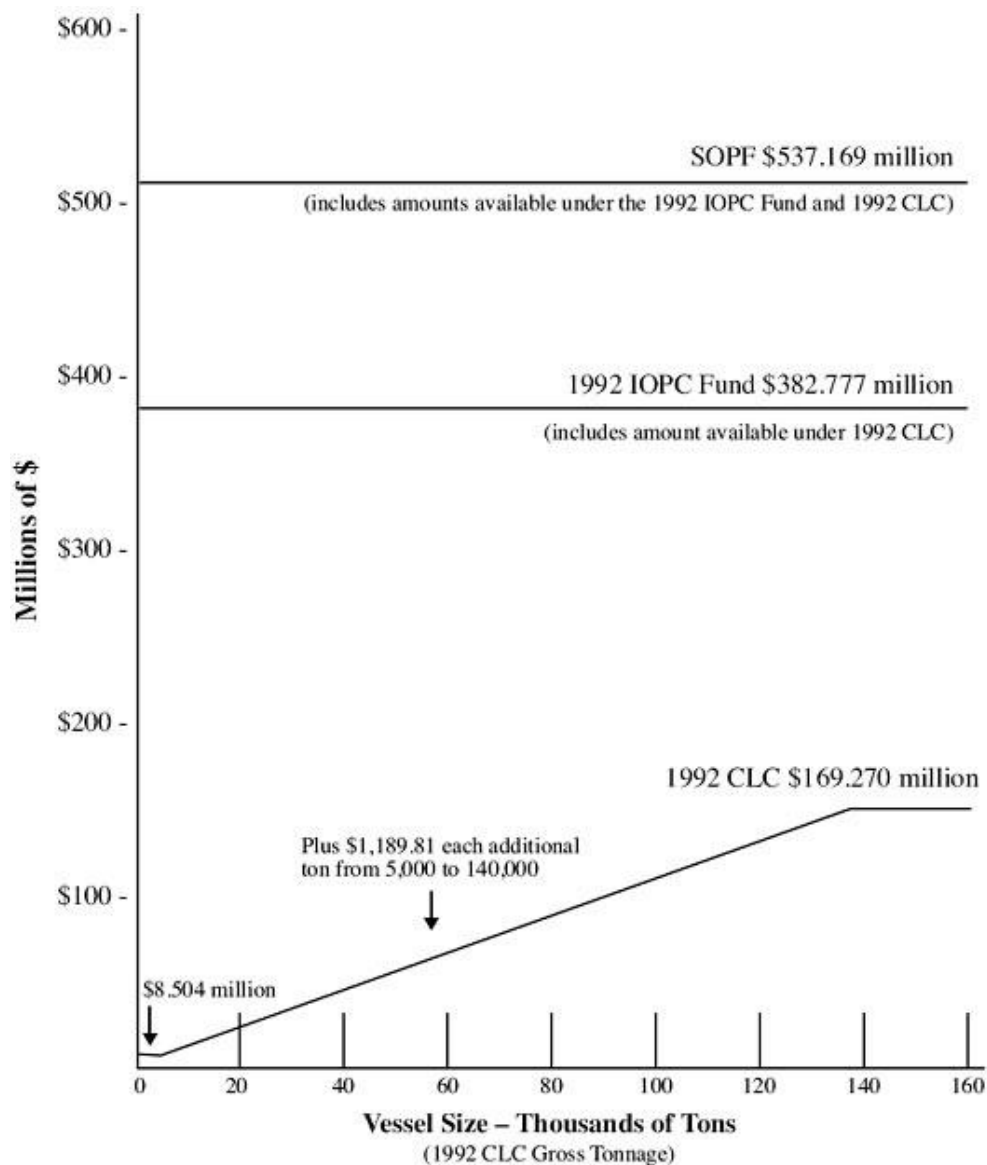


Figure 27 - Current Limits of Liability and Compensation for Oil-tanker Spills in Canada

Source: (Transport Canada: National Oil-spill Preparedness and Response Regime)

The present statutory claims regime of Part 6 of the MLA, on the principle that the polluter should pay, has four cornerstones:

- All costs and expenses must be reasonable;
- All clean-up measures taken must be reasonable measures;

- All costs and expenses must have actually been incurred; and
- All claims must be investigated by an independent authority.

Experience shows that the investigation and assessment of claims is expedited when claimants provide convincing evidence and written explanations. This includes various justifications by the On-scene Commander (OSC) and proof of payment, etc. Detailed logs and notes by the OSC and others are invaluable in facilitating the settlement and payment of claims. It is essential that the measures taken and the costs and expenses incurred are demonstrably reasonable. The claim should also be presented in a timely manner.

5.2.2 SOPF: A Fund of Last Resort

The Canadian Marine Liability Act (*MLA*) makes the shipowner strictly liable for oil pollution damage caused by his ship, and for costs and expenses incurred by the Minister of Fisheries and Oceans and any other person in Canada for clean-up and preventive measures.

As provided in the *MLA*, in the first instance, a claimant can take action against a shipowner. The Administrator of the SOPF is a party by statute to any litigation in the Canadian courts commenced by a claimant against a shipowner, its guarantor, or the 1992 IOPC Fund. In such event, the extent of the SOPF's liability as a last resort is stipulated in Section 84 *MLA*.

The Administrator also has the power and authority to participate in any settlement of such litigation, and may make payments out of the SOPF as may be required by the terms of the settlement.

A Response Organization (RO) as defined in the CSA has no direct claim against the SOPF, but it can assert a claim for unsatisfied costs and expenses after exhausting its right of recovery against the shipowner.

5.2.3 SOPF: A Fund of First Resort

The SOPF can also be a fund of first resort for claimants, including the Crown.

As provided in Section 85 *MLA*, any person may file a claim with the Administrator of the SOPF respecting oil pollution loss or damage or costs and expenses, with one exception. An RO, established under the CSA, has no direct claim against the SOPF.

The Administrator, as an independent authority, has a duty to investigate and assess claims filed against the SOPF. For these purposes, he/she has the powers to summon witnesses and obtain documents.

The Administrator may either make an offer of compensation or decline the claim. An unsatisfied claimant may appeal the Administrator's decision to the Federal Court of Canada within 60 days.

When the Administrator pays a claim, he/she is subrogated to the rights of the claimant and is obligated to take all reasonable measures to recover the amount of compensation paid to claimants from the shipowner or any other person liable. As a consequence, the Administrator is empowered to commence an action *in rem* against the ship (or against the proceeds of sale, if the ship has been sold) to obtain security to protect the SOPF in the event that no other security is provided. The Administrator is entitled to obtain security either prior to or after receiving a claim, but the action can only be continued after the Administrator has paid claims and has become subrogated to the rights of the claimant.

As indicated above, the Administrator has a duty to take reasonable measures to recover from the owner of the ship, the IOPC Fund, or any other person, the compensation paid to claimants from the SOPF. This includes the right to prove a claim against the Shipowner's Limitations Fund set up under the 1992 CLC.

5.3 The International Compensation Regime

The present international regime of compensation for damage caused by oil pollution from oil tankers is based on two International Conventions adopted in 1992 under the auspices of the International Maritime Organization (IMO), a specialized agency of the United Nations. These Conventions are the 1992 Civil Liability Convention (CLC) and the 1992 Fund Convention. The IOPC Fund 1992 established under the 1992 Fund Convention follows an earlier Fund created under the 1971 Fund Convention, which still exists but is in the process of being wound up. On March 3, 2005, an “optional” Supplementary Fund to the 1992 Fund came into force.

The Conventions have been implemented into the national law of the States, which have become parties to them. Canada is a Contracting State to the 1992 CLC and the 1992 Fund Convention, but not the Supplementary Fund.

5.3.1 The Civil Liability Convention

The 1969 and the 1992 CLC govern liability of oil tankers for oil pollution damage. The shipowner is normally entitled to limit his/her liability to an amount that is linked to the tonnage of his/her ship. The source of compensation money comes from insurance (P&I Clubs). Figure 27 shows the limits of liability.

Under the 1969 CLC, the shipowner is deprived of the right to limit his/her liability if the incident occurred as a result of the owner’s actual fault or privity. Jurisprudence provides reasonable prospects for breaking the shipowner’s right to limit liability under this test.

Under the 1992 CLC, claims for pollution damage can be made only against the registered owner of the tanker or his/her insurer. The shipowner is deprived of his/her right to limit his/her liability only if it is proved that the pollution damage resulted from the shipowner’s personal act or omission, committed with the intent to cause such damage, or recklessly and with knowledge that such damage would probably result. This test makes it practically impossible to break the shipowner’s right to limit liability. The shipowner’s limit of liability is higher than in the 1969 CLC.

5.3.2 The IOPC Fund Conventions

Under the IOPC Fund Conventions, which mutualize the risk of oil pollution from tankers, the IOPC Funds pay a supplementary layer of compensation to victims of oil pollution damage in the IOPC Fund - Contracting States that cannot obtain full compensation for the damage under the applicable CLC. The 1971 and the 1972 Fund Conventions are supplementary to the 1969 CLC and the 1992 CLC, respectively. The source of the money is the levies on oil receivers in Contracting States, collected retrospectively. Canada is the exception, where the SOPF pays all Canadian contributions to the IOPC.

The compensations payable by the 1971 IOPC Fund for any one incident is limited to 60 million Special Drawing Rights (SDR, equivalent to approximately \$100 million), including the sum actually paid by the shipowner or his/her insurer under the 1969 CLC. Effective November 1, 2003, the maximum amount payable by the 1992 IOPC Fund for any one incident is 203 million SDR (approximately \$355 million as of April 1, 2007), including the sum actually paid by the shipowner or his/her insurer and any sum paid by the 1971 Fund.

5.3.3 Damage Covered by the Conventions

Any person or company that has suffered pollution damage in a Contracting State of the IOPC Fund 1992 caused by oil transported by ship can claim compensation from the shipowner, his/her insurer and the Fund. This applies to individuals, businesses, local communities or States.

To be entitled to compensation, the damage must result from pollution and have caused a quantifiable economic loss. The claimant must substantiate the amount of loss or damage by producing accounting records or other appropriate evidence.

An oil pollution incident can give rise to claims for damages of mainly four types:

- Property damage;
- Costs of clean-up at sea or on shore;
- Economic losses by fisherpersons or those engaged in mariculture;
- Economic losses in the tourism sector.

Claims assessment is carried out according to the criteria laid down by the representatives of the Governments of Contracting States. These criteria are set out in the IOPC Fund 1992's claims manual, which is a practical guide to the presentation of claims for compensation.

In a number of major cases, the IOPC Funds and the shipowner's insurer have jointly established local claims offices in the country where the oil-spill occurred to facilitate the handling of the large number of claims. Depending on the nature of the claims, the IOPC Fund 1992 uses experts in the different fields to assist in the assessment of claims (Ship-source Oil Pollution Fund, 2007).

5.4 Compensation for Damages from Offshore Petroleum Activity

The Canada-Newfoundland and Labrador Offshore Petroleum Board and the Canada-Nova Scotia Offshore Petroleum Board are responsible for regulation of petroleum exploration and production activities offshore Newfoundland and Labrador, and Nova Scotia.

The authority for matters of compensation in Newfoundland and Labrador is described in the *Canada-Newfoundland Atlantic Accord Implementation Act*, and the *Canada-Newfoundland and Labrador Atlantic Accord Implementation Newfoundland and Labrador Act*.

The authority for matters of compensation in Nova Scotia is described in the *Canada-Nova Scotia Offshore Petroleum Resources Accord Implementation Act*, and the *Canada-Nova Scotia Petroleum Resources Accord Implementation (Nova Scotia) Act*.

Inherent in the nature of oil and gas operations in offshore areas is the risk of damage to the environment and to the property and economic interests of people working and living in areas affected by such operations. Such damage may occur either as a consequence of a “spill” or as a result of “debris” left on the ocean floor. The risk takes on special significance along Canada’s east coast where fishing is a dominant factor in the economy.

5.4.1 Attributable Damage, Non-attributable Damage and Absolute Liability

Attributable is that which can be attributed to a particular work or activity that has been authorized by the appropriate Board.

Non-attributable damage occurs where either the offshore petroleum work or activity is implicated but the actual person responsible for the work or activity (“operator”) giving rise to the damage is not determined, or the source is completely unknown (e.g., a “mystery spill”).

Response Costs

Absolute liability means that the person in whose name the work or activity has been authorized is liable without proof of fault or negligence up to a specified limit for certain damages or expenses attributable to such work or activity.

In response to this concern, the Federal and Provincial Governments have provided both Boards with the mandate to help ensure that all offshore operations are conducted in an environmentally safe manner. Each Board’s mandate is based upon legislation that may permit property owners and fisherpersons to recover economic loss resulting from an oil-spill or debris that can be attributed to an oil company. In addition, the petroleum industry, in cooperation with the fishing industry voluntarily established a

fisheries compensation scheme for damages resulting from seafloor debris for those cases where the responsible party cannot be identified.

These Compensation Guidelines have been prepared to:

- i. Describe the various compensation sources available to potential claimants for loss or damage related to petroleum activity offshore Nova Scotia and Newfoundland and Labrador; and
- ii. Outline the regulatory and administrative roles, which the Boards exercise respecting compensation payments for actual loss or damage directly attributable to offshore operators.

The authority for matters of compensation is the same for both the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) and the Canada-Nova Scotia Offshore Petroleum Board (C-NSOPB).

5.4.2 Compensation Sources

5.4.2.1 Identifying the Source of Damage

Damage caused by offshore oil and gas operations will most likely occur as a result of debris, spill or authorized discharge, emission or escape of petroleum. The appropriate compensation program for persons sustaining actual loss or damage will be determined by whether or not the responsible petroleum operator can be identified.

In most cases, spills associated with offshore petroleum operations can be readily attributed to a specific operator. Operators are required to immediately report any such spills to the appropriate Board and the Canadian Coast Guard. The location of the spill or damage resulting from a spill, combined with the ability to match oil samples through chemical analyses are also valuable in identifying the responsible party.

Damage from Ship-source spills (including from a supply vessel or shuttle tanker), or from spills that cannot be attributed to an offshore petroleum work or activity, should be reported to Transport Canada, Marine Safety Branch, which is responsible for the administration of any claims for damages respecting such spills.

Damage caused by debris may be difficult to attribute to a particular operator or even to offshore petroleum activity if the debris is not recovered. The location of a seafloor obstruction in relation to past or current drilling sites could, however, implicate the offshore petroleum industry (see Section 2.3.1- Compensation Guidelines Respecting Damages Related to Offshore Petroleum Activity). Information on the location of drill sites may be obtained from the offices of the Boards or from their respective web sites

(see Section 4.0 - Compensation Guidelines Respecting Damages Related to Offshore Petroleum Activity). Figure 28 provides a general overview of the compensation claims process.

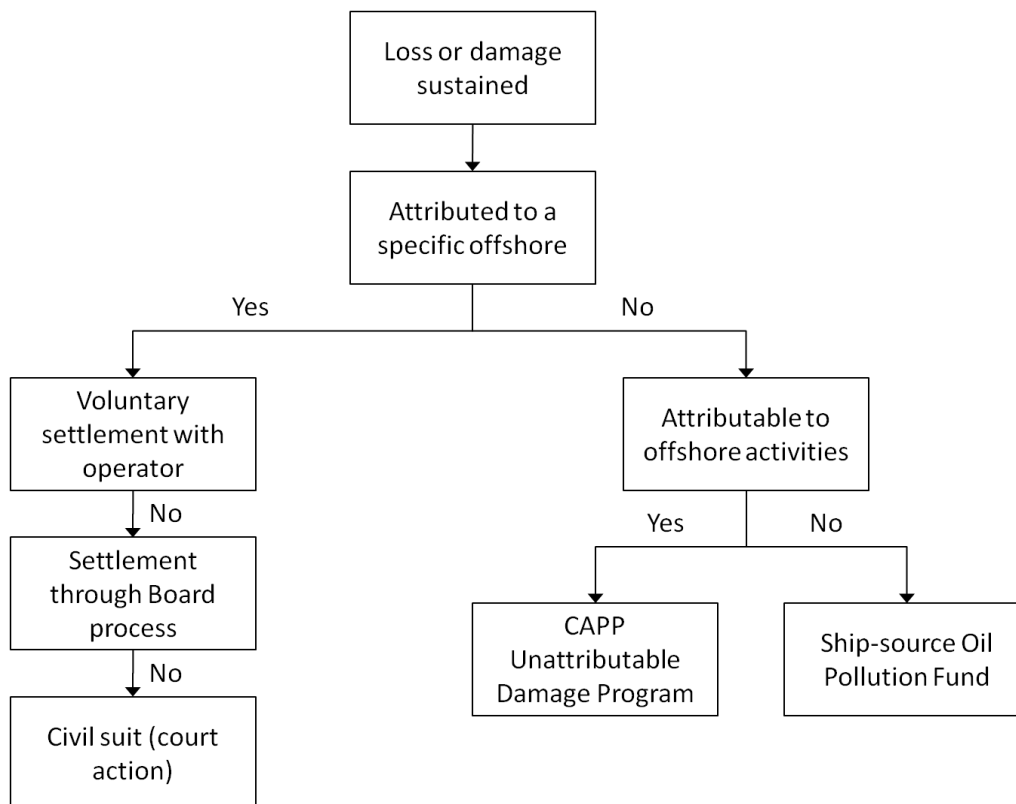


Figure 28 - Compensation Claims Processes

Source: (C-NLOPB, 2010)

5.4.2.2 Attributable Damage

There are three options available to a claimant for the recovery of actual loss or damage when the work or activity giving rise to such loss or damage can be attributed to an offshore operator:

- 1) Voluntary settlement by the operator for direct compensation (refer to Section 2.2.1 - Compensation Guidelines Respecting Damages Related to Offshore Petroleum Activity).
- 2) Application to the appropriate Board for recovery of damages, from the operator's security deposit (refer to Section 2.2.2 - Compensation Guidelines Respecting Damages Related to Offshore Petroleum Activity).
- 3) A civil suit for recovery through the appropriate court of law (refer to Section 2.2.3 - Compensation Guidelines Respecting Damages Related to Offshore Petroleum Activity).

Whereas each of these three options remain available to the claimant at any time, a settlement from the operator responsible for the work or activity giving rise to the damages should be sought before proceeding with other options.

Compensation Directly through Industry

Although there is no legislated requirement for offshore petroleum operators to establish a procedure for compensation, they have traditionally met their obligations in other operations and have expressed a willingness to pay legitimate claims for damages attributed to their work or activity in the east coast offshore areas.

Addresses of the operators' east coast offices and information on their claim processing arrangements may be obtained by contacting the offices of the Boards (see Section 4.0 - Compensation Guidelines Respecting Damages Related to Offshore Petroleum Activity).

Compensation through the Boards

In the event that a claimant is unsuccessful in obtaining satisfactory compensation from the responsible offshore operator, compensation may be sought through the appropriate Board. The Board will review the claim and, depending upon the merits of each case, may award a damage settlement (in whole or in part) directly from the financial security provided to the Board by the operator. In the east coast offshore area, the operator is required to provide proper financial security in the amount of \$30 million for any damages incurred as a result of spills, discharges of petroleum or debris from oil and gas operations. Information respecting payment from such security, together with other details on the Boards' compensation policy is provided in Section 3 of the guidelines.

Compensation through Court Action

The Acts do not limit a claimant's right to bring a civil suit against the responsible operator in seeking to recover damages. Whereas court action may be initiated at any time, such action would likely be considered if the claimant remains unsatisfied after failing to obtain satisfactory compensation either from the operator or through the appropriate Board. Claims in excess of the amount of security provided to the Board by the operator and which therefore require proof of fault or negligence by the operator, will have to be settled through the operator directly or through the courts.

5.4.2.3 Non-attributable Damage

There are two mechanisms in place for compensation for damages of a non-attributable nature:

- i) Canadian Association of Petroleum Producers' Commercial Fisheries Compensation Program for Loss Resulting from Non-Attributable Gear and Vessel Damage (refer to Section 2.3.1 - Compensation Guidelines Respecting Damages Related to Offshore Petroleum Activity); and
- ii) Ship-source Oil Pollution Fund (refer to Section 2.3.2 - Compensation Guidelines Respecting Damages Related to Offshore Petroleum Activity).

CAPP Commercial Fisheries Compensation Program

The purpose of the Program is to provide fair and timely compensation to Canadian commercial fish harvesters, aquaculturalists and fish processors who sustain actual loss because of damage to fishing gear or vessels related to petroleum exploration and development activities within Canada's east coast offshore areas, where the responsible petroleum operator is not known, that is, in cases where the damage is non-attributable.

The aim of the Program is to compensate eligible fisheries industry participants fully and fairly for all such actual loss, leaving participants in no worse or better a position than before the damage occurred.

This Program is an alternative to making a claim through the Courts or other regulatory authorities. Although claims for loss or damage can be made under the laws of Canada, this Program offers a simpler, less-expensive process for obtaining appropriate compensation.

5.4.3 The Board's Policy on Compensation for Attributed Damage

The Boards are empowered to make payments (in whole or in part) directly from the funds available to them through the financial security provided by the responsible offshore operator. Conditions and procedures that would be used by the Boards regarding the payment of funds from these security deposits are discussed below.

5.4.3.1 Policy Objective

The objective is to provide assurance to fishermen and other affected parties that, in the event they suffer actual loss or damage arising from a spill or debris, or incur expenses in taking any remedial action in relation to a spill, all of which can be attributable to an offshore petroleum operator, they will receive both fair and rapid compensation. The Boards' intentions are to adopt the following procedures if and when claimants are dissatisfied with the voluntary compensation arrangements established by the responsible offshore operator.

5.4.3.2 Conditions for Claim Eligibility

There are five conditions that a claimant must satisfy before filing a compensation claim with the appropriate Board:

- 1) ***Damage or loss must be attributable to a work or activity performed by a specific operator.***
Because compensation by the appropriate Board entails the use of funds from security deposits provided by individual offshore operators, access to these funds is restricted to loss or damage claims attributable to a work or activity performed by a specific offshore operator.
- 2) ***Claims are restricted to actual loss or damage resulting from either a spill or debris and/or costs or expenses associated with any remedial action.*** Actual loss or damage occurring directly as a result of an offshore spill or debris may be claimed. Actual loss or damage includes loss of income, including future income, and, with respect to any aboriginal peoples of Canada, includes loss of hunting, fishing and gathering opportunities. Claims may also be made for costs and expenses reasonably incurred for any action taken to remedy a situation involving a spill, including measures taken to control or clean up the spill.
- 3) ***Claims must be received within a specified time period.*** Claims will not be accepted if submitted more than three years after the loss or damage has occurred and in no case later than six years after the spill has occurred or, in the case of debris, six years after the day the installation or structure in question was abandoned or the material in question broke away or was jettisoned or displaced.
- 4) ***The amount of the claim must be within the applicable limit.*** As a condition of conducting work or activity within the offshore area, the operator must provide the appropriate Board with financial security in order to deal with spill-or debris-related claims or classes of claims, up to a maximum amount of \$30 million. In the east coast offshore area, operators are held liable without proof of fault or negligence up to such maximum amount. Notwithstanding this maximum aggregate amount, the Board reserves the right to limit the amount provided for each case or class of cases depending upon the number and scope of claims arising for any given incident. Beyond this allowable amount, the claimant must establish proof of fault or negligence through a court of law or through settlement with the particular person at fault.
- 5) ***Settlement must first be sought from the responsible operator.*** In accordance with its overall compensation policy objective of acting as a "back-up" for voluntary arrangements instituted by the offshore operators, the Boards require that all claims must first be submitted to the responsible

offshore operator. Only in those instances where the claimant and the responsible operator have not been able to reach an agreement, may claims be referred to the appropriate Board.

5.4.3.3 Making a Claim to the Boards

As stated above, where the damages can be attributed to a work or activity performed by a specific operator, the claim for compensation should be submitted to that operator. Contact should be made either directly with the operator or with the appropriate Board for information on the operator's claim procedure.

Where the claimant and the responsible operator are unable to settle the claim, or resolution of the claim is not considered to be proceeding at a satisfactory pace by the claimant, the claim may be referred to the appropriate Board. Claims so referred must be submitted using the Compensation Claim Form (refer to Appendix XVII) accompanied by a copy of all correspondence and attachments, including any invoices, appraisals or other relevant documentation respecting the claim. It is advisable therefore for the claimant to keep copies of all information submitted to an operator.

5.4.3.4 Claims Processed by the Boards

Initial Screening

Upon receipt of a claim but prior to subjecting the claim to the appropriate Board's assessment process, the Board will verify that:

- the claimant has sought compensation from the responsible petroleum operator;
- the claimant has provided the operator with all necessary information and documentation; and
- sufficient time has elapsed to enable the claim to be properly assessed by the operator.

If in the opinion of the Board, sufficient time and information have been made available to properly resolve the claim, the Board will, as an initial step, attempt to achieve a mutually satisfactory agreement between the two parties. Failing a satisfactory resolution of the disputed claim, the Board will review the claim for the purposes of settlement.

Claim Assessment

Once a claim is accepted by the appropriate Board, assessments will be conducted in the following manner:

- Each claim will be evaluated on a case-by-case basis. If needed, advice will be sought from third-party experts.

- In evaluating each claim the Board will first determine its eligibility as per Section 3.2 of the guidelines. If the claim is considered eligible, the Board will determine the size of the settlement. In establishing an appropriate amount, the Board may direct that an independent audit be conducted of costs and expenses claimed.
- It is the intention of the Board to assess and settle each claim as promptly as possible.
- The Board's decision along with reasons for the final determination will be forwarded in writing to both the claimant and responsible offshore operator.

5.4.3.5 Awards

Where awards are made to cover the cost of property lost or destroyed beyond repair, costs so determined will be based upon replacement at equivalent quality. In addition, any claim may be rejected or an award reduced to the extent the claimant has recovered all or a portion of the loss from other sources, or to the extent the claimant by his/her action or inaction, contributed to the damages.

The appropriate Board may also prorate the amount of any settlement if it is thought that the total of all claims may exceed the applicable limit of absolute liability for that particular class of claims.

Finally, the claimant should note that the filing of a claim with the appropriate Board does not prejudice any right by the claimant to commence court proceedings against any responsible party. Pursuant to the Acts, any award obtained from a court proceeding will be reduced by an amount equal to any monies already received by the claimant through the Board.

5.5 Liability Limits in Canada and Other Jurisdictions

Current Canadian laws cap a company's potential liability for damages from a spill at \$40-million in Arctic waters and \$30-million off Eastern Canada. The National Energy Board, which regulates activity in the Arctic, is presently conducting a public review of federal rules, including "financing for spill cleanup, restoration and compensation for loss or damage." The recent Senate committee report on Offshore Drilling Operations has reviewed the status of current liability limits in Canada. The committee recommends a "comprehensive review of the issue of liability, including whether the thresholds should be adjusted to reflect current economic realities" (Standing Senate Committee on Energy, the Environment and Natural Resources, 2010). The executive summary from the senate report as well as the list of recommendations can be found in Appendix XVIII.

In the United States a similar limit exists, called the Oil-spill Liability Trust Fund: operators of an offshore rig face no more than \$75 million in liability for the damages that might be claimed by individuals, companies or the Government, although they are responsible for the cost of containing and cleaning up the spill. The fund was set up by Congress in 1986 but not financed until after the Exxon Valdez ran aground in Alaska in 1989. In exchange for the limits on liability, the Oil Pollution Act (OPA) of 1990 imposed a tax on oil companies, currently 8 cents for every barrel they produced or imported. However, the limits do not apply if it is found that the operator was negligent or had violated Government regulations at the time of the spill. As part of the Government response to the Macondo spill, there has been a legislative push to increase the liability limits significantly, with some legislators calling for it to be raised as high as \$10B.

The OPA also requires a responsible party to submit proof of its financial responsibility to cover environmental cleanup and restoration costs that could be incurred in connection with an oil-spill. Under this Act, parties responsible for offshore facilities must provide financial assurance of at least \$35 million (\$10 million if the offshore facility is located landward of the seaward boundary of a state) to address oil-spills and associated damages, with this financial assurance amount increasing up to \$150 million in certain limited circumstances depending on the risk represented by the quantity or quality of oil that is handled by the facility.

The Polluter-Pays-Principle is a key element of good environmental practice in Australia. The company in charge of the Montara well, which blew out in August 2009, accepted responsibility for reimbursing the Australian Government for the costs of the clean-up, limited environmental monitoring and rehabilitation. However, the current Australian law places no specific liability on the owners of oil wells to pay for the clean-up or environmental damage caused by spills. Companies are only legally required to have insurance to cover the costs of complying with directions relating to the clean-up or other

remediation of the effects of the escape of petroleum. The Australian Government has relied on the goodwill of the company in the Montara incident to recover costs.

In Norway, regulations state that the licensee is liable for pollution damage without regard to fault. The regulations place no limit on the potential liabilities with regards clean-up costs or environmental damage caused by spills. There is a stated exception to this, that if the pollution were determined to be an inevitable event of nature, or due to an act of war, exercise of public authority or a similar force majeure event, then the liability may be reduced to the extent it is reasonable.

The United Kingdom has a strict liability regime in the form of the Offshore Pollution Liability Agreement. All offshore operators currently active in exploration and production on the U.K. Continental Shelf are party to a voluntary oil pollution compensation scheme known as Offshore Pollution Liability Association Ltd. (OPOL). OPOL has been extended to cover facilities in other offshore areas of North West Europe and has the support of the U.K. and other Governments. It is accepted as representing the committed response of the oil industry in dealing with compensation claims arising from offshore oil pollution incidents from exploration and production facilities. OPOL Limits of Liability have been increased over the intervening years to, at the time of the Macondo spill, US\$120 million per incident. In mid-August, this limit was raised to US\$250 million, based on an assessment of potential third-party costs of an oil-spill in modeled spill scenarios. The Oil-spill Advisory Group of OPOL has also commissioned the modeling of additional spill scenarios with the aim of providing a more comprehensive picture of potential oil-spill costs.

5.6 Summary of Liability Issues

With regards to Ship-source spills, the Ship-source Oil Pollution Fund has proved over the years to be an excellent vehicle for compensating Canadian parties affected by a spill. It is well-funded, and combined with international mechanisms such as the Civil Liability Convention and the IOPC Funds, provides up to \$540M in compensation.

With regards to spills resulting from exploration and production operations, in Canada as in most other jurisdictions, there are limits to the potential financial liability of an operator. However, it is important to note that in each of the jurisdictions noted, the limit on liability is intended to apply to damages resulting from the spill and to third-party cleanup costs, and is not intended to place a maximum limit on the costs of the responsible party incurred in controlling the spill or responding to it.

Nonetheless, the Canadian liability limit of \$30M appears to be very low when compared with the potential costs of a large-scale spill, and is significantly lower than a number of recent notable spills in other developed countries, even excepting the unprecedented costs of the recent Macondo incident.

Section 6 – Conclusions and Recommendations

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6.0 Conclusions and Recommendations

6.1 Conclusions

The Macondo oil-spill in the Gulf of Mexico provides a stark reminder that industry and Government must never become complacent. They must always be vigilant in their approach, appreciate the risks being taken, and determine how those risks can be mitigated.

Whereas the Newfoundland and Labrador oil and gas industry is relatively young, it has established an impressive record of safety and success within its exploration and development operations. Canada has a strong focus on applying stringent rules and regulations when it relates to the environment, health and safety. This focus is part of the Canadian social fabric. It is a common focus shared by Government, industry, contractors, service providers and the general public and applies to offshore oil and gas exploration and development, air travel, road and rail. It is a very important factor in all Canadian activities, and such attention helps ensure only international best practices and exemplary safety cultures are tolerated nationwide.

Newfoundland and Labrador has learned from its own past experiences and those from the international stage. The province is keeping abreast and contributing to advancing technologies. It has developed a stringent, progressive regulatory regime, one which is moving, adapting and changing. Indeed, Newfoundland and Labrador is a world leader when it comes to safety and regulatory oversight and is recognized as such globally. The Province's framework and safety record is regularly analyzed by other countries and its practices often implemented. Newfoundland and Labrador, through the International Regulators Forum works cooperatively and effectively with other world leaders such as Norway, the United Kingdom, United States, Australia, Brazil, New Zealand and the Netherlands.

Both industry and the regulators appreciate the critical importance of safety and environmental issues. The theme of this partnership is based on Principle 4 of the *Rio Declaration* which states "In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it."

Energy security, the environment and the economy are very important considerations for Newfoundland and Labrador's policy development and regulatory regime. They relate to job creation, local commercial opportunities, research and development spending, training and infrastructure, and the benefits from taxes and royalty regime payments to Government.

The challenge is finding a way to ensure that reasonable measures are being taken to mitigate risks such that incidents are unlikely to occur, and then if one does occur, there is a method of response - plan to

prevent and plan to respond. It is paramount that the industry and the regulator identify, assess and prioritize the risks and then apply the necessary resources to minimize, monitor and control the probability and/or the impact of unfortunate events.

Newfoundland and Labrador is developing a modern, robust and effective regulatory framework that provides for multiple layers of oversight ranging from technical analysis to environmental systems management and the activities of contingency planning, all of which must be addressed prior to any operator application moving forward. The C-NLOPB is ultimately responsible and accountable for ensuring that the appropriate goals are met, and they exercise that accountability through the oversight provided in the activity approval process. They are there throughout the operation, monitoring activities, auditing and following up to ensure that the industry meets its commitments. Safety and environmental issues are paramount values under the Board's mandate. The Board must continue to demonstrate that they are competent, and efficient in what they are charged to do, accountable for their actions, and be transparent so that Government and the public are confident in their oversight activities. They will also require additional resources and competencies to fulfill these obligations as the industry evolves.

The public must also appreciate that both industry and the regulators have considerable knowledge, competence, and expertise that has been gained from decades of activities and lessons learned from around the world. Such experience serves to enhance confidence in the system. It is important to recognize that the Newfoundland and Labrador regime is being developed responsibly and the associated risks are being reduced and well managed. Since the Macondo spill, Newfoundland and Labrador, and Canada have taken a number of steps to further heighten its vigilance over our own offshore operations and are watching closely for lessons to be learned from that tragedy.

The operating companies offshore Newfoundland and Labrador are world class and well suited for operating in harsh environments. These operators currently apply standards that are higher than required. They are responsible and have had successful operations in other challenging, harsh marine environments. They meet or exceed the regulatory requirements, have good safety training for its workforce, and have well-developed, robust operating procedures. They also have sound safety cultures that extend from the head office to the offshore drill floor. This safety culture is reflected in their impressive safety records. Industry is motivated to conduct its operations in a safe and responsible manner and take care in identifying and mitigating risks.

Based on a review of the conditions in the Newfoundland and Labrador Offshore Area, together with comparison with the regulatory standards of other countries with extensive offshore oil and gas industries, it is concluded that the *Newfoundland and Labrador Offshore Petroleum Drilling and Production*

Regulations provide a sound, comprehensive basis for prevention of spills by avoidance of well blowout during drilling operations to the greatest extent practicable.

Responses to oil-spills are always a combined effort of industry, non-governmental organizations, and federal, provincial and municipal Governments. A four-tiered response system is available depending on the scale and location of the spill. The industry systems, safe practices, safety culture, designs, standards, and training and competency assurance programs are of an international standard and are well-suited for the Newfoundland and Labrador offshore area. This system and standards are further enforced by the C-NLOPB's rigorous and competent oversight and scrutiny in the approval process.

When comparing Canada's prevention and response regime to other similar countries, there is no reason to suggest a move from goal-oriented to a more prescriptive approach. Goal-oriented regulations, and performance based regulations, have served Canada and most other countries well and are the best practice observed in comparable jurisdictions.

6.2 Recommendations

For clarity, the recommendations gathered as a result of this review are broken down into sections. These sections focus on different topics discussed throughout this report. A brief discussion is provided on the topic, followed by the respective recommendations. The recommendations are numbered consecutively to provide clarity.

The recommendations are meant to coincide with the terms of reference, presenting evidenced based reasoning derived throughout the report. Comparisons to other jurisdictions have been a major focus of this report, and many of the recommendations come as a direct result of these comparisons. Several other recommendations are provided which stem from the observations of the authors in conducting this review. The goal of each recommendation is the same: to ensure that Newfoundland and Labrador is fully committed to preventing a spill, has an effective remediation response should an oil-spill occur, and comparable or more prepared than other leading jurisdictions worldwide, setting an example in its level of preparedness.

6.2.1 Offshore Response – Use of Dispersants in the Newfoundland and Labrador Offshore Area

When examining the weather and sea-state conditions offshore Newfoundland and Labrador, the unavoidable conclusion is that a containment and recovery response has severe limitations in its applicability, particularly during winter months.

The weather and-sea state limits for dispersant use are somewhat better, particularly in winter months, and many of the oils produced offshore Newfoundland and Labrador are dispersible for at least a period of time. In all other jurisdictions studied in this review some form of preapproved dispersant usage plan has been established. Currently there is no means of preapproved dispersant usage allotted for Newfoundland and Labrador waters.

Dispersant usage can be controversial in that their use may cause some degree of environmental harm. Prior to their use, one should understand the full scale of the net environmental benefit they provide. To do so, effective research must be applied and/or performed such that a pre-approval process and list can be established. It is recommend that:

1. A dispersant-use capability program be established for Newfoundland and Labrador waters, including the development of a pre-approval process.
2. Establish a means of reviewing and performing relevant research to determine if the use of dispersants can provide a net environmental benefit, and if so, require offshore operators to include the use of dispersants in their oil-spill response plans.

3. Create and fund a system in an appropriate department (Environment Canada) to approve commercial dispersant products that can be used in the waters off Newfoundland and Labrador.
4. Define areas and conditions for the Newfoundland and Labrador offshore in which dispersant usage can be pre-approved.
5. Establish standards for effectiveness and effects monitoring and monitor training similar to the Special Monitoring of Applied Response Technology (SMART) Protocols in the United States. In addition, consideration should also be given to the possibility of dispersant injection at the wellhead, in the event of a subsea oil-well blowout.

6.2.2 Offshore Response – Use of In-situ Burning in the Newfoundland and Labrador Offshore Area

Although the weather and sea-state limits for the use of in-situ burning are no better compared to containment and recovery, burning does offer advantages over skimming in terms of logistics and oil-removal rates. In-situ burning is proving to be a valuable technique for reducing surface oil, as evidenced during the Macondo oil-spill in the Gulf of Mexico. It is recommended that:

6. In-situ burning capability should be considered and developed for Newfoundland and Labrador.
7. Pre-approval for in-situ burning operations, both in open-waters and ice-covered conditions, should have defined standards for effectiveness and effects monitoring.
8. Ensure appropriate response equipment, techniques and training are accessible and listed in Contingency Plans.

6.2.3 Ship-source Pollution – Transport Canada / Canadian Coast Guard National Aerial Surveillance Program (NASP)

The NASP is the primary tool for detecting ship-source pollution in waters under Canadian jurisdiction and is used by Transport Canada and Environment Canada to enforce the provisions of all Canadian legislation applicable to illegal discharges from ships, including the *Canada Shipping Act* and the *Migratory Birds Convention Act*. All comparable jurisdictions employ effective programs similar to NASP.

Aerial surveillance is considered to be the most effective method internationally and is the principle method available to Transport Canada for detecting oil-spills and gathering evidence to prosecute polluters. It also sends a message that Canada will not tolerate pollution activities. The program is effective, but should be constantly enhanced as technology progresses and ship traffic increases. It is recommended that:

9. Transport Canada continues to undertake initiatives to further enhance its NASP. This may include, but is not limited to, an increase in flight surveillance frequency, improvements to the technology used to detect spills, and the expansion of pollution surveillance areas.

Convictions and Fines

Transport Canada is responsible for the monitoring, enforcement, and conviction of spill related activities throughout Canada, and specifically the waters surrounding Newfoundland and Labrador. To ensure Canada, Newfoundland and Labrador included, establishes a reputation to the world that it will not tolerate any spills off its coasts, especially with respect to intentional oil-spills via waste oil, it is recommended that:

10. Transport Canada should continue its diligence in monitoring, enforcement, and conviction activities. Transport Canada must be consistent and stringent in its processes to demonstrate that spills of any sort will not be acceptable in Canadian waters.

Programs

Transport Canada has recently completed a comprehensive assessment of oil-spill risks associated with marine traffic in Newfoundland and Labrador waters, along the south coast of the island. Various recommendations were provided as a result of this assessment in which many are currently in the implementation stage. The recommendations are provided in Section 4.4.3 of this report. It is recommended that:

11. Transport Canada ensure that all recommendations highlighted in their assessments be implemented in a timely fashion to ensure the likelihood of an oil-spill is minimized and that the region is as prepared as reasonably possible in the event of an oil-spill.

Engagement Process

Consultation and engagement with all relevant stakeholders is an essential element of good environmental management and best practices. For Transport Canada, these stakeholders include domestic and international government organizations, academia, industry, oil-spill responders, non-governmental organizations, and the public. It is recommended that:

12. Transport Canada continues to uphold an effective line of communication with its stakeholders to identify oil-spill research needs and establish priorities for future activities. These priorities may be used to direct oil-spill research and development activities at Environment Canada, disseminate any findings, and provide advice to regional and federal agencies managing oil-spills.

13. Transport Canada continues with public engagements and takes measures to improve emergency preparedness at local, regional and international levels to ensure they are commensurate with the level of the risks that exist. This is achieved by continuing to provide forums for information exchange and collaboration, in support of the objectives for improving oil-spill prevention, preparedness and response.

Technology

It is recommended that:

14. Transport Canada participates in oil-spill research programs, keeping educated and up-to-date with modernization.
15. Transport Canada actively participates in researching and utilizing all new oil-spill countermeasure technology, including, but not limited to, mechanical recovery, chemical treating agents, in-situ burning, and natural attenuation.

6.2.4 Offshore Activity – Research and Development

Research and Development (R&D) plays a fundamental role in supporting the efficient production of offshore oil and gas operations and is beneficial to both the operator and government. Of the jurisdictions under study, the Newfoundland and Labrador offshore area is unique with respect to its harsh environment, which includes high winds, rough seas, low visibility, and the presence of sea-ice and icebergs. Today, additional challenges are present as a result of operations in deeper waters. As we continue to move forward, new technologies and new strategies will be required. If not, there is a danger that safety interests may not be addressed adequately. R&D may be used to reduce the risks associated with exploration and production. It is also important to note that R&D does not have to be proprietary to be beneficial. Jurisdictions such as Norway and the United Kingdom have strong R&D processes.

The complexity of the industry dictates that it has a responsibility in the successful development and application of technologies and they must be implemented on a more rapid time scale than traditionally exercised. R&D initiatives which may be of benefit to Newfoundland and Labrador include adequate risk estimation, assessments of the challenges in deepwater drilling operations, studies regarding blowout preventers, drill pipe and well control technology, assessments of personnel protection, oil-spill response and remediation studies, blowout containment technologies, deepwater oil-spill trajectory studies, and the effect of sea-ice on oil-spill response. Industry must also commit adequate resources to research and development targeted at oil cleanup and response technology.

With respect to R&D, it is recommended that:

16. The C-NLOPB, in partnership with industry, create a mechanism that will ensure appropriate R&D activities are confirmed, scheduled, and delivered commensurate with associated risks offshore Newfoundland and Labrador. It may be advisable that the Board ensure that prior to receiving an Approval to Drill a Well (ADW), the operator provide the nature of the R&D initiatives, the perceived outcome, the cost, and the proposed timeframe for delivery.

6.2.5 Offshore Activity – C-NLOPB Oversight

The C-NLOPB is the specific regulatory authority responsible for the regulation and enforcement of safety offshore Newfoundland and Labrador. To maintain the highest levels of safety offshore it is recommended that:

17. The C-NLOPB continue being vigilant in its regulatory oversight responsibility and keep the highest level of scrutiny in relation to its mandate of worker safety, environmental protection, resource management and industrial benefits. This involves the continuance of a high safety standard application and a strict robust monitoring and reporting system. It should also be recognized, that as our industry grows, so shall the oversight responsibilities of the C-NLOPB. This continued growth will require additional financial resources.
18. The C-NLOPB must continue with international involvement, which is an important vehicle that ensures that lessons and practices are shared with relevant regulators and operating companies.
19. The C-NLOPB must keep exploring ways to implement more effective and smarter regulatory frameworks without compromising any aspect of the environment or health and safety of employees or the public.
20. The C-NLOPB must demonstrate more transparency and find ways to communicate industry information and analysis in ways that are accessible to a broad audience. This may be achieved by the Board and industry jointly, by creating an educational and awareness policy for the public and all stakeholders.

6.2.6 Offshore Activity – Liability Limits in Newfoundland and Labrador

The liability limits for offshore well-related spills are far below what would be required for a significant blowout. Although unlimited liability may not be appropriate, nor is it practiced in other jurisdictions, an increase in the existing limits would be justified when compared with the costs of well-control and response that have been realized in recent incidents.

The recent Senate committee report on Offshore Drilling Operations has reviewed the status of current liability limits in Canada. The committee recommends a “comprehensive review of the issue of liability, including whether the thresholds should be adjusted to reflect current economic realities”. These recommendations may be found in Appendix XVIII.

It is recommended that:

21. Government adhere to the senate committee recommendation regarding liability limits in Canada. Specifically, a comprehensive review of the liability limits must be undertaken with the ultimate goal of adjusting the threshold to a value that better represents today’s current economic realities.

6.2.7 Offshore Activity – Well-control and Contingency Planning

Whereas catastrophic blowouts are infrequent occurrences, recent events have demonstrated that such events can prove to be costly with very high social and legal consequences.

It is therefore prudent and in the best interest of the industry and all stakeholders that operators develop safe, strategic and effective methodologies and measures of preparedness and response in the control and management of potential blowouts. This is achieved through developing a strategic contingency plan that would specify a variety of anticipated resources including diverse strategic alliances with other operators, contractors, critical support services, governments and the regulator. Contingency planning is currently in place in the event of a batch spill, but these do not encompass the spectrum of issues that will be present in the event of a catastrophic blowout. Therefore it is recommended that:

22. The C-NLOPB require operators to develop a strategic contingency plan dealing specifically with blowouts. The plan should encompass a total system approach to blowout control, management response and recovery, and demonstrate an acceptable level of preparedness, and the critical resources to manage an incident effectively, including hazard management, incident management, qualification management, information management, and technology management. The plan should not be static but tested to ensure reliability, safety team building and overall confidence.

6.2.8 Offshore Prevention – Community Involvement

In reviewing the various measures undertaken worldwide with respect to oil spill prevention, remediation and response, it quickly becomes clear that the number one area of focus must be prevention. If an oil-spill can be prevented, there will be no harm to the environment and no need for the remediation and response measures. Therefore the number one goal must be to minimize the likelihood of an oil-spill.

With respect to offshore prevention, it is recommended that:

23. The C-NLOPB hold more industry seminars to transfer the knowledge of technology related to deepwater and HPHT wells to the local community. This will further strengthen its regulatory efforts and show leadership within the local community.

6.2.9 Offshore Prevention – Drilling and Production Guidelines

The *Canada-Newfoundland Offshore Petroleum Board Drilling and Production Guidelines* Draft 2009 provides detailed explanatory notes to assist Operators in complying with the intent of the Canada-Newfoundland Offshore Drilling and Production Regulations. These are supplemented by the *Guidelines for Drilling Equipment*, as revised 2007, although the latter set is somewhat outdated and inconsistent with the *Drilling and Production Guidelines*. These guideline sets are critical to ensuring that Operators undertake drilling of wells such that well control is maintained to the greatest extent possible, and in cases where well control is lost, that the well control equipment can be used to prevent blowout and return the well to stable conditions.

It is recommended that:

24. The C-NLOPB modify the current *Canada-Newfoundland Offshore Petroleum Board Drilling and Production Guidelines* to:

- Require, particularly for deepwater wells or wells with anticipated high subsurface temperature and pressure, a comprehensive well-control management plan comprising all of the policies and procedures, equipment standards and training and competencies that ensure well-control during drilling operations, including risk assessment for loss of well-control;
- Include formation fluid influx in the definition of “incident”;
- Ensure automatic disconnect of the stack is undertaken when maximum riser angle is reached (deepwater operations only);
- Remote intervention is available for subsea BOP stacks for all water depths;
- One set of shear rams for deepwater BOP stacks is capable of shearing casing;
- Shear boost systems are considered for BOP stacks installed on platforms;
- Require, particularly for deepwater wells or wells with anticipated high subsurface temperature and pressure, verification of well design prior to issuance of Approval to Drill a Well; and,
- Reconcile with the *Guidelines for Drilling Equipment*, as revised 2007.

6.2.10 Offshore Prevention – Environmental Monitoring and Third-party Auditing

Environmental monitoring deals with the regular inspection of management systems, equipment, operational activities and the associated environmental impact on a regular basis. Such monitoring ensures credibility, including the continuous improvement of active projects, mitigation tools and measures, consultation processes, a vehicle for the application of lessons learned and performance reporting.

Auditing provides a mechanism for comparing environmental management control and regulatory requirements against the management and operational performance history of a facility by comparing such history and systems with a predetermined set of standards.

Third-party auditing is an activity performed by both regulators and operators. Some of these audits are mandatory, while others are not. Due to increased operational risk, advanced technological enhancements and safety requirements it may be prudent to increase third party audits.

Currently, third-party auditing is within the purview of the Board. Security audits are performed by consultants on behalf of the Board. With respect to well control and design, especially in the area of deepwater wells, it is an area which requires specific expertise.

Whereas regular internal auditing is a sound management activity, independent third-party auditing provides an unbiased viewpoint of the associated activities. Third-party auditing will add credibility to internal audit findings, provide transparency through public disclosure, improve company performance, provide international recognition for best practices and standards, provide additional risk mitigation techniques, and enhance environmental policies.

It is therefore recommended that:

25. Third-party auditing be implemented and become normal practice in the Newfoundland and Labrador offshore oil industry, particularly for deepwater wells or wells with high anticipated pressure and temperature. Such auditing should address the adequacy of well design and the implementation of the well-control management system during drilling operations.

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Personal Communications

Name	Organization	Role
Bruneau, Steve	Memorial University of Newfoundland	Professor - Civil Engineering
Johansen, Thormod	Memorial University of Newfoundland	Professor - Petroleum Engineering
Khan, Faisal	Memorial University of Newfoundland	Professor - Petroleum Engineering
Hawboldt, Kelly	Memorial University of Newfoundland	Professor - Petroleum Engineering
Ruelokke, Max	C-NLOPB	Chair and CEO
Kelly, Sean	C-NLOPB	Public Relations Manager
Way, Fred	C-NLOPB	Vice-Chair
Bugden, Jeffrey	C-NLOPB	Manager, Industrial Benefits
Burley, David	C-NLOPB	Manager, Environmental Affairs
Yetman, Todd	Eastern Canada Response Corporation	Operations Supervisor
Aylward, Chris	Eastern Canada Response Corporation	Operations Support
Murphy, Clement	Canadian Coast Guard	Ship Safety
Vokey, Gary	Suncor Energy	Asset Manager
Farrell, Michele	Suncor Energy	HSE Manager
Sacuta, Paul	HMDC	President
Young, Jim	HMDC	
Harnett, Carolyn	ExxonMobil	
Hubele, Terry	ExxonMobil	Drilling and Completions Manager
Downton, Neil	Husky Energy	
Pritchard, Trevor	Husky Energy	General Manager, Operations
Wight, Francine	Husky Energy	HSE Lead
Beresford, Jim	Statoil	Senior Drilling Engineer
Sullivan, Derek	Statoil	HSE Advisor
Andreschefski, Stephen	Chevron	
Piccott, Jill	CAPP	Assistant
Barnes, Paul	CAPP	Manager

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Appendix VIII	Regulatory Environment, Batch-spill Sources and Facility Spill Prevention (Prepared by Hibernia Management and Development Company and presented to Mark Turner and Justin Skinner on June 25, 2010)
Appendix IX	Spill Prevention - Well Design, Well-control and Drilling (Prepared by Husky Energy and presented to Mark Turner and Justin Skinner on June 25, 2010)
Appendix X	Oil-spill Preparedness and Response Overview (Prepared by Suncor Energy and presented to Mark Turner and Justin Skinner on June 25, 2010)
Appendix XI	ECRC-SIMEC Overview (Prepared by ECRC in June, 2010)
Appendix XII	David Pryce Presentation to House of Commons Standing Committee on Natural Resources (Prepared by CAPP and presented on May 13, 2010)
Appendix XIII	David Pryce Presentation to Standing Senate Committee on Energy, the Environment and Natural Resources (Prepared by CAPP and presented on June 22, 2010)

Appendix XIV	U.S. Congressional Subcommittee on Oversight and Investigations letter to Tony Hayward, Chief Executive Officer of BP (Dated June 14, 2010)
Appendix XV	Spill Related Properties of Newfoundland and Labrador Crude Oils
Appendix XVI	Recommendations from the U.S. Department of the Interior Report on Increased Safety Measures for Energy Development on the Outer Continental Shelf (May 2010)
Appendix XVII	Compensation Claim Form and Instructions (per the C-NLOPB and C-NSOPB)
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