REPORT

Process Safety Management: Regulatory Scan

AUGUST 2014
The Canadian Association of Petroleum Producers (CAPP) represents companies, large and small, that explore for, develop and produce natural gas and crude oil throughout Canada. CAPP's member companies produce about 90 per cent of Canada's natural gas and crude oil. CAPP's associate members provide a wide range of services that support the upstream crude oil and natural gas industry. Together CAPP's members and associate members are an important part of a national industry with revenues of about $110 billion a year. CAPP's mission is to enhance the economic sustainability of the Canadian upstream petroleum industry in a safe and environmentally and socially responsible manner, through constructive engagement and communication with governments, the public and stakeholders in the communities in which we operate.

Disclaimer

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Overview

The management of process safety is globally recognized as the primary approach for establishing the required level of safe operations required to manage high-hazard processes.

This summary was prepared on behalf of the CAPP Process Safety Management (PSM) Committee. The purpose is to provide an overview of process safety regulations and best practices in Canada and around the world.

In Canada, many of the regulations required to address process safety management already exist together with responsible regulatory agencies. The key will be identifying the regulatory gaps and overlaps to ensure problem areas are targeted and a cohesive enforcement strategy developed. A joint regulator - industry dialog will be critical to ensure the success of these efforts.

There has already been an extensive amount of work done on this subject. This summary leans heavily on the prior work done by a range of organizations and individuals. These are acknowledged throughout this overview. Links to key documents are provided in Appendix B.
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1 Introduction

The manufacture of chemicals and petrochemicals, oil and gas exploration and production, energy and power generation all involve complex processes with intrinsic hazards that have the potential for catastrophic accidents involving: large scale loss of life, harm to health and extensive environmental damage that need careful risk management. The measures needed to control these hazards are equally complex and not always understood. The management of process safety is globally recognized as the primary approach for establishing the required level of safe operations required to manage high-hazard processes.

This summary was prepared on behalf of the CAPP Process Safety Management (PSM) Task Group. The purpose is to provide an overview of process safety regulations and best practices in Canada and around the world.

There has already been an extensive amount of work done on this subject. This summary leans heavily on the prior work done by a range of organizations and individuals. These are acknowledged throughout this overview. Links to key documents are provided in Appendix B.

1.1 Defining Process Safety

The following definitions are important as they set the risk management framework for process safety in the upstream petroleum industry. Three definitions published by the International Association of Oil and Gas Producers (OGP) - Report #456 are central to the issue of process safety management:

1) **Process Safety**: Process safety is a disciplined framework for managing the integrity of operating systems and processes handling hazardous substances. It is achieved by applying good design principles, engineering, and operating and maintenance practices. It deals with the prevention and control of events that have the potential to release hazardous materials and energy. Such incidents can result in toxic exposures, fires or explosion, and other releases of hazardous energy that could ultimately result in serious incidents including fatalities, injuries, property or environmental damage, lost production.

2) **Asset Integrity**: Asset integrity is related to the prevention of major incidents. It is an outcome of good design, construction and operating practice. It is achieved when facilities are structurally sound and perform the processes and produce the products for which they were designed. The emphasis is on preventing unplanned hydrocarbon releases that may, either directly or via escalation, result in a major incident. Structural failures may also be initiating events that escalate into major incidents.

3) **Major Incident**: An incident that has resulted in multiple fatalities and/or serious damage, possibly beyond the asset itself. Typically initiated by a hazardous release, but may also result from structural failure or the loss of stability that has caused serious damage to an asset (note this is intended to incorporate terms such as ‘Major Accident’ as defined by the United Kingdom’s Health and Safety Executive (HSE).
These definitions are useful in that they expand the scope of process safety moving beyond the chemical refining industry and threshold volumes of high-risk chemicals.

1.2 The History of Process Safety in Canada

Canada does not have an explicit process safety management regulation comparable to the US OSHA 1910.119, EPA 40 CFR Part 68, or COMAH in the United Kingdom. (Acutech) Having no explicit regulations does not mean that process safety management is not applied in Canada. It’s quite the opposite. Canada has been at the forefront of a voluntary cooperative approach to safety, which has seen a reduction of industrial accidents in the past decade.

An examination of the history of PSM in Canada is important for laying the groundwork for this regulatory scan. The following highlights have been extracted by the efforts of others in this regards. A useful summary was presented by Murray Mazca (ACM Automation) at a 2008 safety symposium in Cologne Germany. A link to the paper presented by Mr. Mazca is included in Appendix B. A second document was The Control of Major Accident Hazards in Canada prepared by Queen’s University and linked to in Appendix B.

Canada responded to Bhopal by creating the Major Industrial Accident Council of Canada (MIACC) in 1987. The original purpose of the committee was to investigate if a similar accident could happen in Canada. (Acutech) Experts within government, industry, labour and non-governmental organizations joined together to evaluate the Canadian industrial situation and determine if a similar type of disaster could occur. Essentially, government took a consultative approach with industry, rather than a prescriptive or legislative one. It was deemed unnecessary to impose strict rules and regulations on Canadian industry. The spirit of MIACC, where the goal was to forge consensus, continues on today. (Mazca, 2008)

MIACC was officially dissolved in 1999 due to governance issues and lack of funding, as external stakeholders became unwilling to further financially contribute to the project. Stakeholders agreed to dissolve the organization, as well as to dispose of the intellectual property, which was split between the Canadian Association of Fire Chiefs (CAFC) and a newly formed Process Safety Management Division of the Canadian Society for Chemical Engineering (CSChE). In 2005, the CAFC decided it was unable to continue supporting the work and transferred its intellectual property to the CSChE. (Queen's University/CCPA/CSChE, 2009)

The MIACC lists subsequently became the basis for regulation under Section 200 of the Canadian Environmental Protection Act (CEPA) in 2003, so they have been preserved through regulation, though the performance standard set by Section 200 is far less than the essential level of the 1998 MIACC voluntary stakeholder commitment. In terms of communities, only Ontario has formally followed through, requiring all municipalities in the province to meet the essential level under the Emergency Management and Civil Protection Act 2006. (Queen's University/CCPA/CSChE, 2009)

MIACC's stakeholder, non-governmental approach (was successful) in driving home the message to both communities and the various industrial groups about the importance of prevention, preparedness, and emergency response. However, just like regulated nations, this (work was) just the beginning, and many experts acknowledge that there is still a long way to go. (Acutech)

1.3 **Factors Driving the Need for Change**

Over the last generation, well publicized major incidents have raised concerns with the public, regulators and other stakeholders. While improvements in technical knowledge and management systems have helped to reduce the risk, major accidents continue to happen around the world. As a result, the public expectations of senior leaders are changing.

1.3.1 **Critical Events**

Highly publicized, international loss of primary containment incidents that have defined process safety including notable oil rig disaster\(^2\). Relevant examples include:

- Flixborough, United Kingdom, 1974
- Seveso, Italy, 1976
- Bhopal, India, 1984
- Permex LPG Terminal, Mexico City, Mexico, 1984
- Grangemouth, Scotland UK, 1987
- Piper Alpha Platform (Offshore), UK Continental Shelf, 1988
- Arco, Channelview, Texas, 1991
- Esso Longford Gas Plant, Victoria, Australia, 1998
- Texas City, Texas, Marathon 1987, BP 2005
- Buncefield Oil Depot Fire, Hertfordshire UK, 2005
- ConAgra Foods, North Carolina, 2009
- Macondo (Offshore), Gulf of Mexico, 2010

Publications by Andrew Hopkins, Trevor Kletz and Atherton & Gil have served to raise process safety awareness and publicize the lessons from these and other incidents.

Canada has also experienced large magnitude incidents with global process safety implications including:

- Lodgepole Well Blow-out, Alberta, 1982
- Ocean Ranger, (Offshore), Hibernia, Canada, 1982
- Westray Mine Explosion, Nova Scotia, 1992
- Sunrise Propane Explosion, Toronto, 2008

These significant events have brought public attention to the risks held in the oil and gas industries and have escalated world attention on process safety management. Recent pipeline and transportation incidents are further increasing media and regulatory attention on process safety management in Canada.
1.3.2 Changing Regulatory Focus

We are witnessing an evolution in regulatory thinking. Three important shifts are taking place and gaining momentum:

1) A Shift from Rule-Based to Performance-Based Regulation
2) A Shift from Personal Safety to Process Safety
3) Increased Attention on Corporate Safety Culture

These are important considerations when assessing the state of current regulations and the best path for advancing process safety within the Canadian oil and gas industry.

1.3.3 Stakeholder Attention

The publicity created by recent major incidents has raised public awareness of the issues of asset and infrastructure integrity, and corporate leadership. The recent Lac-Mégantic rail incident is a useful example.

On one hand, the incident has raised legitimate questions regarding the management of transportation risk and how we handle hazardous substances in Canada. These issues are highlighted in a letter written by Yves Dubeau, a consultant in risk management and emergency preparedness from Montreal and a member of the Process Safety Management Division of the Canadian Society for Chemical Engineering. The letter originally appeared in the July 24, 2013 issue of La Presse. Two questions raised are:

- At the Federal level, is it time to strengthen the transportation of dangerous goods (TDG) act and the federal regulation on environmental emergencies? Producers and transporters must be asked not only to produce emergency response plans but also to put in place full fledge risk management programs?
- At the provincial level, are tougher land use planning guidelines (LUP), risk communication programs and emergency response regulations at the local level required? Do Worker Compensation Boards in each province need to be involved in PSM type program implementation in industries.

On the other hand, the letter highlights some of the dangerous public and media misconceptions that are starting to take place, as highlighted by the paragraph below:

> The time is ripe for Canada to review the way hazardous substances are managed in this country, from cradle to grave as some people say. The voluntary approach to manage hazardous substances that the country has embraced in the late 80’s and early 90’s, which resulted in the creation of the Responsible Care© initiative and the Major Industrial Accidents Council of Canada (MIACC) has proven to be unsustainable and ineffective in the long run. The result is that our country is lagging at least 20 years behind other OECD jurisdictions in programs and regulations concerning hazardous substances. This is making the public reluctant to accept projects that involve the

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2 http://www.chemistrymatters.ca/?p=1002
presence of hazardous substances in their neighborhood, thus threatening the economic viability of several industries in the country. Public confidence towards industry and government agencies must be rebuilt.

The implications of this opinion need to be carefully considered. While MIACC could not be sustained, Responsible Care has become the world standard for process safety. More importantly, process safety management cannot provide the solution for every industrial incident, no different than any other single regulatory or management system approach.

1.3.4 Multi-National Corporations

The role of multinational corporations cannot be understated. In Canada, process safety is being advanced by companies who are active in jurisdictions where PSM is currently regulated. As such, these corporations have a strong influence on the agenda and solutions advanced through the industry associations as well as the contractors hired to execute work plans. While corporations can demonstrate compliance with the regulations in the jurisdictions that they operate, the manner in which they achieve compliance varies from organization to the next. There is no one-size-fits-all solution.
1.4 **Elements of a Process Safety Management System**

All process safety management programs cover the same basic requirements, although the number of program elements may vary depending on the criteria used. Regardless which government, company or association source document is used as a guide, there are a number of basic requirements which should be included in every chemical process safety management program. (Krause, 2011)

As an example, Table 1-1 provides a comparison of four different PSM standards. The similarities and differences highlight both the common elements that define process safety and differences that underscore the challenges (A link to OSHA 3132, *Process Safety Management*, is provided in Appendix B for more information on this subject.).

Regulators are recognizing that the commonly understood elements of a process safety management system need to be considered. There is also increased acknowledgement that “strong leadership is vital, because it is central to the “safety culture” of an organization, and it is the culture which influences employee behaviour and safety. Process safety tasks may be delegated, but responsibility and accountability will always remain with the senior leaders, so it is essential that they promote an environment which encourages safe behaviour.” (OECD, 2012)

As part of the OECD Chemical Accidents Programme a guidance document on Corporate Governance for Process Safety was prepared. This document identifies the five essential elements of corporate governance for process safety which are summarized by Figure 1-1.

A link to OECD’s document is provided in Appendix B.

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![Figure 1-1 Integrating HSE and Process Safety Management Systems](image-url)
In many organizations, the management programs for process safety, environmental, occupational health and safety and quality assurance have developed separately. Yet these programs have many similarities and common needs such as hazard identification, equipment integrity, chemical hazards data, inspections and audits, and documentation systems. In an era when resources are becoming more scarce, there is a growing recognition of the need to integrate PSM and HSE systems into one ‘quality’ management system. Factors driving the need for integration include:

- increasing and overlapping regulatory demands
- pressures to reduce costs of operation and at the same time improve performance
- pressure to improve effectiveness of PSM and HSE performance
- pressure to find permanent solutions to address recurring problems

These factors apply to both regulators and industry.
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¹ Based on Table 1.8 from AIChE Guidelines for Risk Based Process Safety, Center for Chemical Process Safety, 2007 (p.13)
² Based on US Department of Labour Publication OSHA 3132 Process Safety Management, 2000
⁴ Based on the 2012 CSChE’s PSM Guide which is based on the original 1989 AIChE PSM recommendations.
1.5 Relevant Canadian Regulation and Standards

In Canada, there is a perceived lack of provincial and federal control over process facilities and a perception that Canada’s approach to regulating the production, storage, and transport of hazardous substances - including crude oil - is based largely on voluntary initiatives. While the perception there are no explicit process safety management regulations in Canada may be true, an examination of existing regulations reveals many of the requirements of a PSM system are addressed by current regulations.

In examining Canadian safety regulations, it is important to keep in mind that one of the key reasons for the development of our unique legislative environment is based on the division of powers within our constitution. The federal government, through Labour Canada, is responsible for workplace health and safety, but it only has jurisdiction over certain workplaces that cross provincial boundaries (e.g., railroads, federal employees). Labour Canada has no authority whatsoever in almost all process industry plants, which fall under the jurisdiction of the provinces. (Mazca, 2008)

1.6 Occupational Health and Safety Regulation (General Duty Clauses)

On March 31, 2004, 12 years after the 1992 Westray coal mine explosion which killed 26 miners, Bill C-45 - Amendments to the Criminal Code Affecting the Criminal Liability of Organizations, often referred to as the “Westray Bill,” came into force and became law. In short, Bill C-45 significantly lowers the threshold for organizations to be charged and convicted of criminal negligence. It deals only with the criminal responsibility of the organization and makes no change in the existing law dealing with the personal liability of directors, officers and employees. (Mazca, 2008)

This lack of federal control over process facilities explains to a great degree why Canada has relied so much on industry to adopt best practices initiatives like the Canadian Chemical Producers Association’s Responsible Care® program. Since both federal and provincial governments share responsibility for the environment, there has been more active federal government involvement in the area of the environment. (Mazca, 2008)

While provincial OHS regulations do not explicitly address process safety management, they do address a significant number of the elements inherent to an effective PSM system. These are highlighted in Table 1-2 which provides summary comparing existing Alberta OHS regulations to the CCPS’s twenty recommended PSM elements.

1.7 Energy Regulators and Relevant Regulations (AER, OGC, NEB)

Energy regulators play a critical role relative to addressing the objectives of process safety:

National Energy Board (NEB)

The National Energy Board (NEB) has jurisdiction over offshore energy development, frontier oil and gas, and trans-provincial pipelines. While regulations administered by the NEB do not explicitly identify the requirements
as process safety management, all of the key elements of a PSM system are entrenched in key regulations including the *Canada Oil and Gas Drilling and Production Regulations*. The NEB is amending the *Onshore Pipeline Regulations* to require the integration of programs and functions in management system design and implementation.

The reaction of the Canadian public to recent high-profile offshore drilling incidents and pipeline failures, have escalated the level of attention being given by the NEB to safety management systems as highlighted in their 2013 Forum on ‘Emerging Issues in the Oil and Gas Industry Safety Management’ and is included in Appendix B.

**Alberta Energy Regulator (AER) / BC Oil and Gas Commission - OGC**

Relevant to the development of the upstream oil and gas industry, the AER provides mandatory direction through legislation, regulations, directives, codes of practice, informational letters, and board or court decisions. Key areas of attention with process safety impacts include:

- protection of air quality
- sour gas development and public safety
- pipeline safety including public safety and response to pipeline incidents, pipeline integrity management; and the safety of pipeline near water bodies
- well integrity including well equipment standards, well design, operations standards, and the management of associated long-term liabilities

Based on current AER requirements, Table 1-2 highlights the existing Alberta energy regulations which address the recommended elements of a PSM system.

### 1.8 Environmental Regulations (CEPA E2)

The Canadian Environmental Protection Act (CEPA, 1999), Section 200 requires companies that have more than threshold quantities of 174 specified hazardous materials to prepare environmental emergency plans and to notify government bodies. While there is no explicit mention of Process Safety Management, the well developed guidelines and practices of the Center for Chemical Process Safety (CCPS) are referenced as possible tools to follow to conduct risk studies.

The CEPA Environmental Emergency (E2) Plan requirements are worth highlighting for a number of reasons:

- In principle, it targets many of the same issues as the US EPA RMP requirements.
- It is a chemical listing - it has not and may never achieve the intended goal.
- It is an example of more regulation adding to bureaucracy.
- It does not work effectively because it fails to recognize efforts being made on a provincial level and does not consider the need for an integrated approach.

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1.9 Technical Safety Regulations (Alberta Safety Codes Council, BC Safety Authority, TSASK. Also Provincial Energy Regulators (AER, OGC, SER, NEB)

Current regulations governing the design and operation of oil and gas processing buildings and facilities require companies to establish integrity management programs. The focus of the programs is to improve both process and occupational safety by reducing the number and severity of process-related incidents, especially loss of primary containment events. Key plans and programs integral to meeting the objectives of process safety include:

- **Well Equipment Standards:** The critical issue is ensuring the equipment provided by each contractor is aligned with objectives of the Owner’s well program and the technical requirements needed to achieve the drilling objectives. Well equipment standards are based on a combination of AER well-related directives and Industry Recommended Practices developed by the Drilling and Completions Committee (DACC), a joint industry-regulator committee.

- **Boilers and Pressure Equipment Safety Code Compliance:** Under the Alberta Boiler Safety Association (ABSA), owners and contractors are responsible for the safe operation of their boilers and pressure equipment. They are required to establish an inspection program to ensure that these responsibilities are met, ensuring that the inspection of all boilers, fired heaters, pressure vessels and piping systems that contain an expansible fluid above 103 kPa (15 psi) are completed under an approved Pressure Equipment Integrity Management Plan, as required under the provincial pressure vessel regulations ([ABSA AB 512: Pressure Equipment Integrity Management Requirements in Alberta](#)).

- **Management Plan Requirements for Storage Equipment:** The Owners, and in some cases contractors, are responsible for implementing an Integrity Management Plan for Storage Equipment to ensure that operation of all storage facilities is in compliance with [AER Directive 055: Storage Requirements in the Upstream Petroleum Industry](#). Similar requirements have been established by both the British Columbia and Saskatchewan energy regulators.

- **Pipeline Integrity Management Plans:** Once a pipeline is successfully constructed and tested for operation, it is the responsibility of the Owner/Licensee to ensure that it is operated and maintained in a manner consistent with the regulations. To address this requirement, Owners are required to develop a Pipeline Integrity Management Plan Manual (formerly referred to as Pipeline Operating and Maintenance Manuals) to provide guidelines for the operation and maintenance of its production pipeline systems. CSA Z662 - Oil and Gas Pipeline Systems forms the foundation for the required plans and practices.

- **Electrical Safety Code Compliance:** It is important to utilize licensed contractors to ensure that the design, construction, maintenance and operation of electrical equipment are in compliance with provincial electrical regulations and standards. Both the Owner and Service Contractors are
responsible for ensuring electrical inspections and maintenance are completed in accordance with CSA C22.1-06 Canadian Electrical Code Part 1, the Code for Electrical Installations at Oil and Gas Facilities (2006) and provincial regulations established by the responsible authority.

- **Gas Safety Code Compliance:** As required to comply with provincial gas safety requirements, all fuel gas installations for gas fired equipment are to be installed in accordance with CSA B149.1-05, Natural Gas and Propane Installation Code and provincial gas regulations. This includes the installation of propane tanks at wellheads and installations where raw gas is being used as fuel.

- **Measurement Equipment QA/QC:** The Owner is responsible for ensuring production measurement standards and activities at all oil and gas production facilities are completed in accordance with regulations [AER Directive 017: Measurement Requirements for Oil and Gas Operations](#) or BC OGC 07-21.

Each of these programs requires implementation of various elements of a process safety management system. Specific Alberta-based examples are highlighted in Table 1-2.
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<td>Multiple Facility Directives (i.e. 055, 056 &amp; 073). Also Drilling Directives.</td>
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### Table 1-3 Summary Comparing Existing BC Regulations to Recommended PSM Elements

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Table 1-4 Summary Comparing Existing Saskatchewan Regulations to Recommended PSM Elements

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* NOTE: The Technical Safety Authority of Saskatchewan (TSASK) was established on July 1, 2010 to oversee the safe construction, installation and operation of Boilers, Pressure Vessels, Elevating Devices and Amusement Rides. Supporting requirements similar to those in Alberta and BC have not yet been established.
1.10 Dangerous Goods Transportation (Transport Canada)

The Railway Safety Act was amended in 1999 and added requirements for railway companies to develop, implement and maintain a safety management system. Independent research commissioned by a Transport Canada review panel noted that integration of safety management system requirements into Transport Canada’s regulatory oversight has been inconsistent from region to region. Nonetheless, the conclusion was made that safety management systems offer a significant advantage over traditional, prescriptive, rule-based models. 4

The Transportation Safety Board of Canada (TSB) is responsible for advancing transportation safety including marine, pipeline, rail and air. One of the ways it does this is through the investigation of incidents and the resulting recommendations to federal departments and other organizations to eliminate or reduce safety deficiencies. Specific to the oil and gas industry, this would include the National Energy Board and pipeline related incident investigations.

1.11 Other Provincial PSM Related Regulations

While this regulatory scan focuses primarily on the upstream oil and gas industry in western Canada, there are some PSM-related regulatory initiatives in other provinces worth noting:

**Nova Scotia / Newfoundland**

A Royal Commission concluded the Ocean Ranger had design flaws, particularly in the ballast control room, and that the crew lacked proper safety training and equipment. Major legislative and regulatory changes were made to the Atlantic Accord Acts by the federal and provincial governments to establish strict safety guidelines that must be followed from the initial design of an offshore project to the actual implementation of safety systems during the operations phase. These prescriptive regulations govern the requirements of offshore safety. (Mazca, 2008)

For a Canadian example of prescriptive standards, consider the two jurisdictions on the East Coast of Canada: Newfoundland - governed by the Canada Newfoundland Offshore Petroleum Board, and Nova Scotia - governed by the Canada Nova Scotia Offshore Petroleum Board. In these jurisdictions, oil and gas production units must comply with Drilling, Installation, and Production Regulations of the respective Boards. Only then will they be eligible for a Certificate of Fitness from an approved Certifying Authority; and all floating units must comply with the Transport Canada Marine Safety Regulations. (Mazca, 2008)

**Ontario**

In 2003, the province adopted the Emergency Management Act, which outlined the responsibilities of local/municipal and provincial government in the mitigation and management of emergency situations. It requires all Ontario municipalities to develop comprehensive, risk-based emergency management programs based on planned emergency prevention, preparedness, response and recovery. It resulted

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from a combination of real and feared disasters, including the 1999 ice storm, Y2K concerns, 9/11 and the SARS epidemic of 2003. (Mazca, 2008)

After consultation with stakeholders, the Occupational Health and Safety Act (OHSA) was revised to include Section 7 on Pre-Start Health and Safety Review (PSR), and the new PSR legislation came into force in October 2000. In May 2001, the Ministry of Labour published a detailed, comprehensive guideline outlining how Section 7 of the Industrial Regulation is to be implemented.

In November 2001, the Association of Professional Engineers of Ontario (PEO) finalized its PSR Guideline that adopts and supplements the Ministry of Labour Guideline. These guideline documents are meant to be used together and provide clear guidance on what must be reviewed and on what constitutes an exemption. However, they do not provide clear guidance on the extent to which the engineer providing the PSR should prescribe the measures to be taken to address any identified deficiencies. For this reason, there is a good deal of variability in the cost and quality of the PSR reports, depending on the reviewer.

Quebec

Passed in 2001, this Act was in response to recognized deficiencies in the emergency response plans. The 1996 Saguenay flood and the 1999 ice storm had put the public at risk and the Act provided for the protection of persons and property against disasters, through mitigation measures, emergency response planning and recovery operations in the case of disasters. (Mazca, 2008)

1.12 Standards Council of Canada

The Standards Council of Canada (SCC) has identified Canada’s oil and gas sector as one of five key economic sectors where increased standardization could increase Canada’s international competitiveness. As such, SCC secured and developed bilateral working agreements with over 10 national oil and gas industry association executive teams. To date the effort has focused on identifying standardization issues of relevance to the industry and to examine possible solutions. The harmonization of occupational health and safety regulations in western Canada is one initiative to result from this effort.

Canada is recognized as a world-class leader in developing technology as well as creating governance structure to management safety and the environment. Canada participates in almost 60 per cent of all international technical standardization committees of the International Organization for Standardization (ISO). The Canadian Standards Association (CSA) accounts for over 53 per cent of all domestic standards prepared by SCC accredited Standards Development Organizations. Key CSA standards important to this overview include:

- National Building Code, Fire Code and Electrical Code
- CSA Z662 – Oil and Gas Pipeline Systems

Each of these documents incorporate PSM concepts specific to their focal point. It is also worth highlighting that many CSA standards have been adopted as ISO standards.
Leveraging the Standards Council of Canada to promote and help facilitate state-of-the-art standards to improve upstream oil and gas safety is viewed as an important opportunity. This should include a continued emphasis on key issues including pipeline safety and process safety, two issues getting national and international attention. The reality is this that there is a rapidly growing number of ‘conflicting’ process safety management models, both regulatory and voluntary. Conformity to a Canadian process safety management system standard would be appropriate and timely.

1.13 Canadian Industry Initiatives

**Canadian Society of Chemical Engineering (CSChE)**

With the dissolution of the Major Industrial Accidents Council of Canada (MIACC) in the fall of 1999, a vacuum was created for the furtherance of PSM in Canada. This void was filled by the CSChE through their technical programs, workshops, and conferences, and by providing a forum for chemical engineers and other professionals to study and advance PSM in Canada. The Process Safety Management Subject (PSM) Division of the Canadian Society for Chemical Engineering is a national network of volunteers with a particular interest in the field of Process Safety Management.

CSChE’s PSM Division, which aligns with the efforts of CIAC (as discussed below), has released several useful publications and tools with the goal of reducing the likelihood and consequences of process-related incidents and improving performance through the understanding and application of PSM. These publications played an important role in preparing this regulatory scan and are available through their website www.cheminst.ca/psm.

**Chemistry Industry Association of Canada (CIAC)**

Formerly known as the Canadian Chemical Producers Association (CCPA), this organization was responsible for the development of a unique “ethic” for the safe and environmentally sound management of chemicals in the late 1970’s, before Bhopal. The Responsible Care® initiative was launched in 1985 and is a Canadian success story. It is the world’s leading voluntary industry initiative and is run in 60 countries whose combined chemical industries account for nearly 90 per cent of global chemicals production. (Mazca, 2008) Internationally, Responsible Care® is overseen by the International Council of Chemical Associations.

Given the global impact and success of Responsible Care®, the key principles are important to reinforce:

- work for the improvement of people's lives and the environment, while striving to do no harm
- be accountable and responsive to the public, especially our local communities, who have the right to understand the risks and benefits of what we do

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• take preventative action to protect health and the environment
• innovate for safer products and processes that conserve resources and provide enhanced value
• engage with our business partners to ensure the stewardship and security of our products, services and raw materials throughout their life-cycles
• understand and meet expectations for social responsibility
• work with all stakeholders for public policy and standards that enhance sustainability, act to advance legal requirements and meet or exceed their letter and spirit
• promote awareness of Responsible Care, and inspire others to commit to these principles

Three Responsible Care® codes of practice form the foundation for this initiative:

1) The Operations Code outlines how Responsible Care® companies should manage their facilities and equipment to ensure that they are operated in a safe and responsible way. Companies must work to continuously improve the environmental performance of operations and reduce resource consumption.
2) Under the Stewardship Code, companies must regularly review the value, impact and safety of the products that they make, and the services and technologies that they use. They must also work with their business partners – suppliers, distributors and customers – to ensure the stewardship and security of their products over their entire life cycle.
3) Finally, the Accountability Code requires companies to communicate the risks and benefits of their operations to those who live beside their plants, or in communities along transportation corridors, as well as to other stakeholders, and to work to address any concerns that they may have.

Every three years, a team of industry experts, public advocates and representatives chosen by local communities visits each CIAC member company and interviews senior managers. A link to the CIAC Global Charter is included in Appendix B.

**Canadian Association of Petroleum Producers (CAPP)**

While the members of CAPP are well versed in the principles of process safety, the organization itself has been silent on the issue. Built on the principles of Responsible Care®, the Responsible Canadian Energy™ Program represents a collective commitment by CAPP’s member companies to continuously improve, measure and report performance in the areas of people, air, water and land, and engage collaboratively with the communities in which industry works. The key principles of process safety management are implicit in this initiative.

Broader efforts in conjunction with Enform are being advanced, a driving imperative for this regulatory scan.
Enform

Representing the six upstream oil and gas industry associations, Enform was created as a not-for-profit organization dedicated to meeting industry’s safety needs. While Enform has not been active with respect to PSM, a number of important initiatives advanced by Enform provide important PSM foundation pieces for the upstream petroleum industry:

- The Certificate of Recognition (COR) program is an initiative that recognizes employers who implement and maintain a health and safety management system that meets established provincial standards. Companies with an effective health and safety management system can create a culture of proactive workplace safety. Enform is recognized by Occupational Health and Safety Regulators as the Certifying Partner of the Certificate of Recognition program for the Canadian Oil and Gas Industry.

- The Drilling and Completions Committee (DACC) is responsible for the development of recommended technical operating practices for the upstream oil and gas industry in the areas of drilling, completions and servicing of wells. The primary focus of DACC is to develop technical recommended practices, where the objectives include cost efficiencies, technical optimization, productivity, safety and environmental performance. The resulting Industry Recommended Practices (IRPs) provide important guidance targeting process safety issues related primarily to upstream drilling and completion activities.

- Enform currently offers close to 100 safety-related courses. Courses that address PSM related issues include: emergency response, and well blow-out prevention, to name two.

Canadian Council of Ministers of the Environment (CCME) ²

An important example of a Canadian solution to the process safety related issue is the “Environmental Code of Practice for Aboveground Storage Tank Systems Containing Petroleum Products.”

Historically, the National Fire Code of Canada (NFCC) and Canadian Standards Association (CSA) requirements have been used in Canada for the installation and operation of underground storage tanks containing petroleum products. These codes were written from the viewpoint of fire prevention and primarily cover the elements of fire prevention and fire safety.

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² [http://www.ccme.ca/assets/pdf/pn_1326_eng.pdf](http://www.ccme.ca/assets/pdf/pn_1326_eng.pdf)
In the late 1980s, the Canadian Council of the Ministers of the Environment (CCME) saw a need to provide recommended practices that went beyond the scope of these documents and provided an environmental perspective on the management of storage tanks containing petroleum and allied petroleum products. The resulting document was first published in 1988.

Federal, provincial, and territorial jurisdictions agreed that the existing underground and aboveground codes of practice should be updated to keep pace with changes in the National Fire Code, reflect new CSA requirements, and take advantage of advances in technology. It was also decided to combine the existing aboveground and underground CCME codes into one comprehensive document. This document incorporates all the key elements of a process safety management system as it applies to the design, installation operation and maintenance of storage tanks.
2 US & International Process Safety Management Regulation

As the United States provides a number of “best practices” for industry around the world, it is important to look at the state of American regulation. It should be noted, however, that there has been significant criticism in recent years of U.S. hazardous substances laws. (Queen’s University (CCPA/CSchE), 2009) The OSHA PSM standard and the EPA Risk Management Program were the first U.S. Federal regulations specifically designed to prevent major chemical accidents that could harm workers, the public and the environment. (Marca, 2008)

2.1 Occupational Safety and Health Administration (OSHA - PSM) 8

In 1990, under the auspices of the Clean Air Act Amendments, the U.S. Department of Labor issued a report to the President to “look beyond existing OSHA standards to the best company and industry control measures and systems for managing the hazards of the chemical process.” 15 In 1992, OSHA issued Standard 29 CFR 1910.119 Process safety management of highly hazardous chemicals. (Marca, 2008). The emphasis of this OHSA mandate was the regulation of workplace safety.

The intent of the rule is:

to prevent or minimize the consequences of a catastrophic release of toxic, reactive, flammable or explosive HHC's (high hazard chemicals) from a process. A process is any activity or combination of activities including any use, storage, manufacturing, handling or the on-site movement of HHC's. A process includes any group of vessels which are interconnected and separate vessels which are located such that a HHC could be involved in a potential release. The rule intends to accomplish its goal by requiring a comprehensive management program integrating technologies, procedures, and management practices.

To achieve compliance, OSHA’s 14-element PSM program has become the foundation for PSM regulations and programs worldwide. While the specific elements can be debated, the intended objectives are still sound:

- Accountability
- Hazards identification and control of hazards
- Knowledge and control of the operation
- Accidents and learning from accidents

The specific elements are highlighted in Table 1-1.

It is interesting to note that following the implementation of PSM, one analysis reported an accident reduction of 40 per cent in 5 years and 80 per cent in 6 years. It is difficult to argue with those results. 9 Also worth a brief mention are OSHA’s Hazard Communication regulations which form one element in the PSM foundation, namely Process Safety Information.

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8 https://www.osha.gov/SLTC/processsafetymanagement/
2.2 Environmental Protection Agency (EPA / RMP)

The 1969 Cuyahoga River fire helped spur the creation of the Environmental Protection Agency (EPA). The EPA is an agency of the federal government of the United States charged with protecting human health and with safeguarding the natural environment: air, water, and land. (Mazca, 2008)

In 1985, increasing public concern led the U.S. Environmental Protection Agency (EPA) to begin its Chemical Emergency Preparedness Program (CEPP), a voluntary program to encourage state and local authorities to identify hazards in their areas and to plan for chemical emergency response actions. In 1986, Congress adopted many of the elements of CEPP in the Emergency Planning and Community Right-to-Know Act. (Mazca, 2008)

The Clean Air Act (CAA) Amendments of 1990 authorized both EPA’s Risk Management Program, and OSHA’s Process Safety Management standard. As noted above, OSHA was mandated by Section 304 of the Clean Air Act to develop chemical accident prevention and emergency response regulations to protect workers at hazardous chemical facilities. The EPA’s mandate was focused on community safety. The resulting Risk Management Program (RMP) regulations (40 CFR Part 68) are similar to OSHA’s PSM standard. The 11 RMP elements cover many of the same toxic and flammable chemical substances, and require a similar set of accident prevention requirements.

The EPA has published a use guideline document pertaining to the General Duty Clause that applies to all regulations, including those in Canada. A link is included as Appendix B.

2.3 Bureau of Safety and Environmental Enforcement (BSEE) and US Coast Guard (ASCG)

In the wake of the Macondo disaster, regulation of the offshore industry on the Outer Continental Shelf (OCS) has undergone profound change, both in terms of the agencies who regulate and the substantive regulations. A new agency was formed, the Bureau of Ocean Energy Management, Regulation, and Enforcement that ultimately became two related agencies: (1) the Bureau of Ocean Energy Management, which handles lease sales and permitting of OCS wells; and (2) BSEE, which handles regulation with regard to safety and operational requirements for activities on the OCS. While this overhaul of the former MMS was dramatic and comprehensive, it did not affect the traditional, historic jurisdiction of the United States Coast Guard (USCG) over vessels and certain aspects of other OCS facilities.

Of note, the BSEE requires companies operating on the Outer Continental Shelf to implement a Safety and Environmental Management System (SEMS) that complies with the American Petroleum Institute (API) Recommended Practice RP75 - Recommended Practice for Development of a Safety and Environmental Management Program (SEMP) for Offshore Operations and Facilities. The USCG also issued a notice of proposed rulemaking to seek comment on a proposed rule that would require all vessels engaged in Outer Continental Shelf activities -
including both domestic and foreign-flagged vessels - to develop, implement, and maintain a vessel-specific SEMS program that incorporates API RP75.

### 2.4 Department of Transportation (DOT)

Similar to Canada, the US Department of Transportation is responsible for a range of transportation safety issues including aviation, pipelines, rail and ground transport. Similar to Canada, DOT has long advocated the implementation of safety management systems and has prepared a guidance document on the subject that is a useful reference for any industry. 10

Related to this, the National Transportation Safety Board (NTSB) is an independent Federal agency charged by Congress with investigating every civil aviation accident in the United States and significant accidents in other modes of transportation – railroad, highway, marine and pipeline. The NTSB determines the probable cause of the accidents and issues safety recommendations aimed at preventing future accidents. In addition, the NTSB carries out special studies concerning transportation safety and coordinates the resources of the Federal Government and other organizations to provide assistance to victims and their family members impacted by major transportation disasters.

One relevant investigation worth highlighting is related to the Enbridge pipeline leak in Wisconsin in 2012. In response to the pipeline leak, the Pipeline and Hazardous Materials Safety Administration (PHMSA), a US DOT agency responsible for developing and regulating US-based pipelines, issued a Corrective Action Order to Enbridge. The order required Enbridge to submit a Restart Plan before returning the line to service. The report highlights the emphasis on two important issues:

1) safety culture and integrated management systems
2) integrity verification programs including inspections, testing and quality management systems

While not presented specifically as process safety management, the regulatory and public expectations are 100 per cent in alignment. The role of US DOT is important and meaningful.

### 2.5 Chemical Safety and Hazard Investigation Board (CSB) 12

The U.S. Chemical Safety and Hazard Investigation Board, known as CSB, was authorized by the Clean Air Act Amendments of 1990 and became operational in 1998. The CSB is an independent federal agency charged with investigating industrial chemical accidents. The principal role of the Chemical Safety Board is to investigate accidents to determine the conditions and circumstances which led up to the event and to identify the cause or causes so that similar events might be prevented. 17 (Mazca, 2008) The CSB does not issue citations or fines but does make safety recommendations to plants, industry organizations, labour groups, and regulatory agencies including OSHA and EPA.

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A vocal critic, the CSB continues to push OSHA and the EPA on PSM issues not often seen as hazardous, such as dust explosions from seemingly innocuous facilities. One analysis credited to the CSB noted that of 167 significant incidents reviewed beginning in 1980, more than 50 per cent were not covered by PSM regulations.

The following CSB recommendations are worth including in this regulatory scan in that they highlight important PSM issues:

- Recommendation to ensure coverage under the Process Safety Management (PSM) standard for atmospheric storage tanks that could be involved in a potential catastrophic release as a result of being interconnected to a covered process with 10,000 pounds of a flammable substance. The recommendation was issued in 2002 following the CSB’s investigation of a 2001 explosion of a poorly maintained, corroded storage tank.
- Recommendation to revise the PSM standard to require management of change (MOC) reviews for organizational changes such as mergers and acquisitions that may impact process safety. This recommendation, issued in 2007, followed the 2005 explosions and fire at the BP Texas City refinery which killed 15 workers and injured 180 others.
- Recommendation that OSHA issue a fuel gas safety standard for construction and general industry. This recommendation issued in June 2010 followed two catastrophic accidents that occurred that year: In one, an explosion caused a roof collapse at the ConAgra Slim Jim facility in Garner, North Carolina, killing four workers and injuring 67 others. A worker had been attempting to purge new natural gas piping during the installation of an industrial water heater, resulting in a large release of natural gas indoors. In the other, at the Kleen Energy power plant in Middletown, Connecticut, high-pressure natural gas was being used to clean new piping and was released in a congested outdoor area. It ignited, killing six workers and injuring at least 50.

Ultimately, the belief of the CSB is that revisions to the current PSM / RMP regulations is required and strengthened enforcement is required, an opinion not shared by OSHA or EPA.

2.6 State Legislation

In addition to federal standards, many states have enacted their own legislation, including:

- New Jersey’s Toxic Catastrophe Prevention Act (1986),
- California’s Risk Management and Prevention Program Regulations (1988),
- Delaware’s Extremely Hazardous Substances Risk Management Act (1989),
2.7 US-Based Industry Initiatives

There is no question that US-based industry organizations provide a significant amount of worldwide leadership on PSM system development and implementation.

American Institute of Chemical Engineers (AIChE) 13

AIChE is the world’s leading organization for chemical engineering professionals, with over 45,000 members from over 90 countries. AIChE has the breadth of resources and expertise ranging from core processing industries to emerging areas such as nanobiotechnology. Driving the PSM agenda is the Center for Chemical Process Safety (CCPS), a not-for-profit, corporate membership organization within AIChE that identifies and addresses process safety needs within the chemical, pharmaceutical, and petroleum industries. The CCPS is discussed further in Section 5.1 of this review.

American Petroleum Institute (API) 14

The American Petroleum Institute (API) is the only national trade association that represents all aspects of America’s oil and natural gas industry. More than 400 corporate members, from the largest major oil company to the smallest of independents, come from all segments of the industry. They are producers, refiners, suppliers, pipeline operators and marine transporters, as well as service and supply companies that support all segments of the industry.

In 2004, API issued RP75, Recommended Practice for Development of a Safety and Environmental Management Program (SEMP) for Offshore Operations and Facilities. This recommended practice was the first comprehensive safety and environmental management standard of its kind in the world. This integrated management system guideline was created to cover the spectrum of safety and environmental activities, procedures and operating hardware. It incorporates a range of issues including company culture, objectives and operations.

In April 2010, API published API Recommended Practice (RP) 754, Process Safety Performance Indicators for the Refining and Petrochemical Industries. The purpose of the RP is to identify leading and lagging indicators in the refining and petrochemical industries for nationwide public reporting, as well as indicators for use at individual facilities, including methods for the development and use of performance indicators. Of note, the U.S. Chemical Safety Board (CSB) has formally voted to classify the American Petroleum Institute’s (API) response to the Board’s recommendation to develop a system of performance indicators as “Open- Acceptable Action.”

American Fuel and Petrochemical Manufacturers (AFPM)

The American Fuel & Petrochemical Manufacturers (formerly known as the National Petrochemical & Refiners Association) is a trade association representing American manufacturers of virtually the entire U.S. supply of

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13 http://www.aiche.org/ccps/topics/overview
gasoline, diesel, jet fuel, other fuels and home heating oil, as well as petrochemicals. Fuel and petrochemical manufacturers’ safety practices are regulated by OSHA’s Process Safety Management Standard for Highly Hazardous Chemicals and EPA’s Chemical Accident Prevention Program, as well as several other OSHA General Industry standards.

The AFPM\(^\text{15}\) works closely with API to establish, implement and evaluate process safety management initiatives which include:

- AFPM / API Process Safety Performance Metrics and Event Sharing Program
- AFPM Process Safety Hazards Identification Program
- API Process Safety Training and Certification Program
- API Process Safety Site Assessments Program

American Chemistry Council (ACC)\(^\text{16}\)

The first major step taken by American industry in response to Bhopal was the formation of the Community Awareness & Emergency Response (CAER) program in 1985. The program was adopted in 1988 by the American Chemistry Council (formerly the Chemical Manufacturers Association) to improve emergency response planning in communities near chemical facilities. (Mazca, 2008) In 2013, the 25\(^{\text{th}}\) anniversary of Responsible Care in the United States, ACC launched an enhanced Responsible Care that strengthens industry’s commitment to the safety and includes new operational energy efficiency and performance measurements.

National Institute for Occupational Safety and Health (NIOSH)\(^\text{17}\)

In 2007, NIOSH introduced Prevention through Design (PtD). While not a traditional PSM program, it is based on the same underlying principle: designing out occupational hazards in equipment, structures, materials, and processes. It is worth noting in that the program targets small employers who fall outside the scope of the more expansive PSM regulations.

\(^{15}\) [http://www.afpm.org/Advancing-Process-Safety-Programs/](http://www.afpm.org/Advancing-Process-Safety-Programs/)

\(^{16}\) [http://responsiblecare.americanchemistry.com/](http://responsiblecare.americanchemistry.com/)

2.8 International Process Safety Management Regulations

Throughout the world, the majority of process safety related regulations utilize US PSM regulations for the foundation. However, the following summary highlights that the nature and scope of those regulations varies significantly from country-to-country based on perceived risks and culture.

2.8.1 European Union (Seveso I, II and III, REACH, ORSEC)

Following a fire and explosion of a small chemical manufacturing plant in Seveso Italy in 1976, the resulting public outcry led to the European Community passing the Seveso Directive in 1982, which imposed much harsher industrial regulations. In the UK, the Control of Industrial Major Accident Hazards (CiMAH) Regulations were passed in 1984. The Seveso Directive was updated in 1999, amended again in 2005 and is currently referred to as the Seveso II Directive or COMAH (Control of Major Accident Hazards Regulations) in the United Kingdom.

The Seveso Directive obliges Member States to ensure that operators have a policy in place to prevent major accidents. Operators handling dangerous substances above certain thresholds must regularly inform the public likely to be affected by an accident, providing safety reports, a safety management system and an internal emergency plan. Member States must ensure that emergency plans are in place for the surrounding areas and that mitigation actions are planned. Account must also be taken of these objectives in land-use planning. Seveso is a tiered approach to the level of controls: the larger the quantities of dangerous substances present within an establishment, the stricter the rules ('upper-tier' establishments have bigger quantities than 'lower-tier' establishments and are therefore subject to tighter control).

Further adaptation of the provisions on major accidents occurred with publication of the Seveso III Directive 2012/18/EU which entered into force on 13th August 2012. Member States are required to transpose and implement the Directive by 1st June 2015, which is also the date when the new Globally Harmonized System (GHS) of Classification and Labelling of Chemical now in force in Europe and is being adopted in North America.

What makes the European situation interesting is that Seveso II is a minimum standard and countries modify the plan when they implement it. This leads to a fragmented set of regulations throughout Europe with different countries having vastly different plans. For example, France assesses facilities based on the damage caused by a worst-case scenario accident and ignores the probability of such an accident occurring, a very interesting philosophical approach.

Essentially, the European legal system has set up a number of chemical requirements at several different levels, from the municipal up to the continental. The patchwork of laws results in jurisdictions, levels of enforcement and

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requirements that all vary based on location and time. What seems to be the basic summation is that if one works with chemicals in any industrial capacity the presence of the chemical must be reported to government regulators and a safety plan must be developed (be it a plan to phase out the chemical, or a plan to make its use safer).

(Queen's University (CCPA/CSchE), 2009)

Finally, it is important to mention the Registration, Evaluation and Authorisation of Chemicals (REACH) directive. While this legislation is not targeted at process industry companies and in fact does not target accidents at all but rather the long term health consequences of chemicals, it is extremely complex legislation that could easily be read to apply to process industry companies, especially in the long term. The most dramatic effect of REACH is that if a chemical is deemed to be dangerous, industry will need to seek government permission to use it. As of yet there is no list of “dangerous” chemicals so it is impossible to know just how large the scope of this legislation is and its impact on process industry companies.

(Queen's University (CCPA/CSchE), 2009)

2.8.2 United Kingdom (COMAH - CIMAH)

In the UK, the Control of Major Accident Hazards (COMAH) Regulations came into force on April 1, 1999, with the intent of ensuring that businesses

*take all necessary measures to prevent major accidents involving dangerous substances*” and to “*limit the consequences to people and the environment of any major accidents which do occur.*

The COMAH regulations were further amended in 2005.

The COMAH regulations implement Council Directive 96/82/EC known as the Seveso II Directive, as amended by Directive 2003/105/EC and replaced the Control of Industrial Major Accident Hazards Regulations 1984 (CIMAH). COMAH applies mainly to the chemical industry, but also to some storage activities, explosives and nuclear sites, and other industries where threshold quantities of dangerous substances identified in the Regulations are kept or used.

The Competent Authority responsible for enforcement comprises three organizations:

1) The Health Safety Executive (HSE),
2) The Environment Agency (EA - for England and Wales) and
3) The Scottish Environmental Protection Agency (SEPA).

The Competent Authority Strategic Management Group (CASMG) is responsible for setting a strategic direction and plan of work for the Competent Authority as a whole. Importantly CASMG is responsible for reporting back publicly on progress both in the UK and the European Union.

One related item worth noting is that land-use planning requirements of the Directives are implemented by separate land-use planning legislation and the responsibility of other regulatory authorities.
World class supporting information is extensive and available on the HSE website. 19

2.8.3 Norway / North Sea (Safety Case)

In response to the 1988 fire and explosion on the Piper Alpha, the Lord Cullen’s report precipitated sweeping changes to legislation covering offshore safety. This included the Offshore Installations (Safety Case) Regulations. A Safety Case is a written document in which a company must demonstrate that an effective Safety Management System (SMS) is in place on a particular offshore installation. (Mazca, 2008)

2.8.4 Australia / New Zealand (Major Hazard Facilities)

Longford was Australia’s catastrophic industrial accident that sparked legislative change. While the number of deaths was low and the plant damage was modest, public outrage was extremely high. The resulting Major Hazard Facilities Regulations (2004) were a direct outcome of the Longford incident and were aimed at regulating safety at plants that contain major chemical hazards. They are proactive and performance-based standards, whereby a general expectation of performance is established, but the detailed interpretation of the performance benchmarks and how to achieve them are left to the industrial plant operator. Australia also follows the Safety Case regime developed in the UK following Piper Alpha. (Mazca, 2008)

The Dangerous Goods Safety (Major Hazard Facilities) Regulations 2007 (MHF Regulations) are one of seven sets of regulations that give effect to the Dangerous Goods Safety Act 2004. In addition to the MHF Regulations, other relevant regulations include:

- The Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007, which require a dangerous goods license to be obtained for the storage and handling of prescribed levels of dangerous goods on the site.

Australia is often compared to Canada in terms of control of major industrial accidents because the government structures are so similar. Both countries have federal and provincial governments with each level having different areas of authority and responsibility. In both Canada and Australia the control of major accident hazards is basically a provincial, not a federal, area of responsibility. (Queen's University (CCPA/CSchE), 2009)

The Australian federal legislation on this matter is interesting in that it is non-binding and to be put into effect it must be adopted by the states and territories. However, it provides a ready-made and instantly available framework should the states want to implement a PSM requirement. (Queen's University (CCPA/CSchE), 2009)

19 http://www.hse.gov.uk/comah/index.htm
The text of the legislation itself is fairly lackluster. It does not deal with many of the elements needed in a good PSM system and instead focuses on reporting, notification and development of safety plans. Realistically the legislation’s purpose is to have companies seriously think about safety issues and potentially instill in them the sort of safety culture necessary for them to independently adopt a full PSM scheme. (Queen's University (CCPA/CSchE), 2009)

2.8.5 SE Asia

A brief overview of three examples from SE Asia is worthwhile in that they highlight differing regulatory approaches

**Japan – High Pressure Gas Safety**

In Japan, the handling of high-pressure gas, and manufacturing of facilities and equipment to handle high-pressure gas, is regulated by the High Pressure Gas Safety Act. Any person who handles high-pressure gas must understand the High Pressure Gas Safety Act before attempting to handle such gas. The purpose of this act is to prevent disasters caused by high-pressure gas and secure public safety. Details of the act mainly consist of:

- conformity of facilities and equipment with technical regulations
- preparation of manuals related to safe administration by the operators, and
- Allocation of qualified personnel.

In addition to the High Pressure Gas Safety Act for regulating the high-pressure gas itself, coordination is established with the Fire Services Act designed to prevent and extinguish the fire, the Industrial Safety and Health Law designed to ensure the health and safety of industrial workers, and the Act on the Prevention of Disasters in Petroleum Industrial Complexes and Other Petroleum Facilities designed to prevent occurrence of disasters within areas of petrochemical complexes, thereby maintaining the safety of high-pressure gas handling in Japan.

**Korea – SMS** (Queen's University (CCPA/CSchE), 2009)

The current industrial situation in South Korea is quite different from Canada, mainly because South Korean industry is based around family-owned industry rather than corporate entities (U.S. Department of State, 2008). During the 1960s instability in North Korea and Vietnam created a need for South Korea to modernize its military, and the government formulated an economic plan to develop heavy and chemical industries. Banks were directed to provide low-interest loans to family-owned conglomerates, which eventually dominated the free-market industry.

This provided an industrial environment where profit was more important than process safety, and the conglomerate essentially defined process safety management in South Korea. In the late 1980s and early 1990s the rising amount of fatalities and destroyed communities resulting from chemical site explosions caused the South Korean public to advocate a regulatory regime from the

http://www.khk.or.jp/english/dl/hpgact_overview.pdf
government. As a response to public pressure the government developed federal regulations for process safety management (Cha Ming, 2008).

Federal intervention was provided in the form of the Minister of Labor reviewing safety report forms provided by all industry. The following excerpt from a Korean Occupational Safety and Health Agency (KOSHA) documentation release summarizes the regulatory procedure for process safety reporting outline which forms the basis of the federal regulation:

- An employer of hazardous installations shall submit the process safety report to the Ministry of Labor/KOSHA under the Presidential Decree for preventing major industrial accidents such as fire, explosion and release of toxic chemicals which can cause a serious danger to employees, residents in the nearby community.
- The process safety report prepared by the employer shall be reviewed by the Safety and Health Committee in the workplace before submission. If the committee has not been established, the report shall be reviewed by the representative of employees.
- The Ministry of Labor/KOSHA shall assess the process safety report and can order the employer to change the report in case it is necessary for the safety and health of employees.
- An employer and employees shall take necessary measures in compliance with the process safety report.

According to a news release by the KOSHA, since the implementation of the aforementioned federal regulations the numbers of fatalities, injury rates, and near-hits fell by 62 per cent, 58 per cent, and 82 per cent respectively. Additionally, technical data, such as P&ID’s and HAZOP’s were improved. The number of emergency shutdown cases was decreased and property damage was reduced.

**Singapore**

The Singapore approach to process safety management is based on the holistic approach taken by the Ministry of Manpower (MOM) which integrates occupational health and safety with process safety principles. Key considerations include:

- Initial efforts in 1993 were based on a 10-element recommended practice which was closely modeled after OSHA’s PSM Regulations and API RP 750.
- In 2001, this evolved into a 14-element Code of Practice stipulated under the Factories Act encompassing both OHS and PSM elements.
- In 2006 Singapore launched a national standard, SS 506: Part 3 creating a certifiable standard comprising PSM and OHS elements to be used as the foundation for certification and registration. This effort was targeted at factories and the chemical industry. Associated regulations included a registration and 5-year renewal process.

Current efforts appear targeted at improving PSM performance measurement.

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2.9 International Process Safety Management Standards

The following organizations are worth highlighting as each has influenced the development of process safety management worldwide.

2.9.1 Center for Chemical Process Safety (CCPS)

The CCPS is the worldwide PSM authority bringing together manufacturers, government agencies, consultants, academia and insurers to lead the way in improving industrial process safety. CCPS member companies, working in project subcommittees, define and develop useful, time-tested guidelines that have practical application within industry.

The project topics run the gamut of areas important to manufacturers and range from human factor issues to qualitative and quantitative risk analysis to security vulnerability to inherently safer design. With over 100 publications to date, CCPS remains at the forefront of issues relevant to industry. Many of these publications form the foundation for this regulatory scan.

In order to protect people, property and the environment, CCPS is committed to bringing the best process safety knowledge and practices to industry, academia, the government and the public around the world through collective wisdom, tools, training and expertise. The four pillars and the twenty elements of risk based process safety, as depicted in the figure below, can be designed and implemented at varying levels of rigour to optimize process safety management, performance, efficiency, and effectiveness.

The 2013 publication, “Vision 2020” and the Five Tenet Descriptions and Four Societal Themes are useful barometers of the quality of guidance available from CCPS. The espoused philosophies underpin the summary discussion in Section 3.

2.9.2 International Association of Oil & Gas Producers (OGP)

As highlighted by their webpage, the International Association of Oil & Gas producers (OGP) is a unique global forum in which members identify and share best practices to achieve improvements in every aspect of health, safety, the environment, security, social responsibility, engineering and operations. The Association was originally formed in 1974 to develop effective communications between the upstream industry and an increasingly complex network of
international regulators. Today the OGP encompasses most of the world's leading oil & gas companies and major upstream service companies.

As noted on the web page, major process incidents happen relatively infrequently, the industry cannot afford to rely on lessons from these alone. To strengthen safety barriers and prevent these incidents from occurring at all, it is necessary to collect, collate and analyze data from less severe incidents and shortfalls in management system performance.

In the downstream sector, recommendations issued following the US Texas City Refinery and UK Buncefield oil terminal incidents reinforced the urgent need for improved key performance indicators (KPIs). In 2008, OGP published Asset Integrity – the key to managing major incident risks, which set out how to implement an asset integrity management system for new and existing upstream assets. It also provided guidance on developing leading and lagging KPIs. Leading indicators maintain barrier strength. Lagging indicators measure barrier defects, events and consequences.

Since then, based on work conducted by the American Petroleum Institute (API) and the Center for Chemical Process Safety (CCPS) on process safety key performance indicators for downstream operations, OGP has developed an equivalent guide for the upstream industry. Process Safety: Recommended Practice on Key Performance Indicators emphasizes the importance of having in place and actively monitoring multi-level barriers to prevent an incident from happening and then stopping it from escalating should those initial barriers fail. The report also advises companies on selecting KPIs for prevention and mitigation. \(^{(OGP)}\)

### 2.9.3 Energy Institute

The Energy Institute is a professional body supporting the power generation and fossil fuel industries in the UK. The EI has over 19,000 individual member and 250 corporate members worldwide. The current organization evolved in 2003 as a result of the merger between the Institute of Petroleum and the Institute of Energy. 2014 marks 100 years since the EI’s oldest founding institution was formed. The formation of the EI reflects the increasing convergence of various sectors of the UK energy industry.

The EI produces an extensive range of technical guidance, standards, and research reports for the energy sector including process safety. The EI Process Safety Committee has developed high-level 20-element framework for process safety management (‘PSM framework’), a comprehensive process safety management framework which

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\(^{22}\) [https://www.energyinst.org/home](https://www.energyinst.org/home)
captures industry good practice in process safety management (PSM).

The framework targets two important questions:

1) How will we assure the integrity of the operation?
2) How will we know we are doing it?

The Energy Institute provides a number of useful PSM resources to its members.

2.9.4 International Labour Organization (ILO) 23

The ILO Prevention of Major Industrial Accidents Convention, 1993 provides an overview of broad controls. The accompanying code of practice explains the coverage of the convention in more depth. The scope of the ILO Code of Practice on the Prevention of Major Industrial Accidents can be accessed via the link provided below. (Queen's University (CCPA/CSchE), 2009)

2.9.5 Organization for Economic Co-operation and Development (OECD)

Similar guidance to the ILO model is provided by the OECD, which provides advice related to the role and responsibilities of public authorities, industry, employees and their representatives, as well as interested parties such as members of the public potentially affected in the event of an accident, and non-governmental organizations. For specific information, refer to the OECD website (OECD Guiding Principles for Chemical Accident Prevention, Preparedness and Response, 2003). (Queen's University (CCPA/CSchE), 2009)

The work of the OECD related to corporate governance for process safety is carried out by the Working Group on Chemical Accidents (WGCA). The Chemical Accidents Programme works in three areas: developing common principles and policy guidance on chemical accident prevention, preparedness and response, analyzing issues of mutual concern and making recommendations for best practices, and facilitating the sharing of information and experience between both OECD and non-member countries. It is carried out in co-operation with other international organizations. The Program helps public authorities, industry, labour and other interested parties prevent chemical accidents and respond appropriately if one occurs. (OECD, 2012)

2.10 International Association of Drilling Contractors (IADC) 24

Since 1940, the International Association of Drilling Contractors (IADC) has exclusively represented the worldwide oil and gas drilling industry. IADC’s mission is to advance drilling and completion technologies, improve industry health, safety, environmental and training practices, and champion sensible regulations and legislation which facilitate safe and efficient drilling. Membership is open to any company involved in oil and gas exploration, drilling or production, well servicing, oilfield manufacturing or other rig-site services.

Related to PSM, the IADC HSE Case Guidelines for both offshore and onshore drilling rigs have become increasingly popular with drilling contractors in many

areas around the world. The Guidelines provide a framework for developing an integrated health, safety and environmental management system for use in reducing the risks associated with offshore and onshore drilling activities.

The Guidelines provide the worldwide drilling industry with a means of harmonizing global health, safety and environmental principles applicable to drilling units into a single methodology tailored to the drilling contractor community. This framework will greatly assist regulatory bodies, drilling contractors, and oil and gas producers in achieving higher degrees of personnel safety and environmental protection worldwide.

Interestingly the guidelines and associated references were prepared pre-Macondo and do not include any specific PSM references. A critical review of IADC’s 131 page Legislative Index for Land Drilling includes extensive PSM terminology that addresses every element of an acceptable PSM system.
3 Learnings and Recommendations

The provincial regulators have identified the shortcomings in process safety management in comparison to other jurisdictions and either have or are considering implementing aspects of it. In many cases, the regulators are not specifically identifying these changes as a process safety management regulation but the principles are consistent.

As with any management system, an effective solution needs to consider three elements as shown in the adjacent diagram:

1) Product
2) Equipment
3) People

More importantly, the solutions need to consider the interrelationships between these elements. With this in mind, the following seven learnings and recommendations are proffered.

3.1 Integrated Regulatory Approach

The legislative and regulatory framework in the U.S. is not one Canada should implement as a whole. First, 90 per cent of the U.S. work force comes under federal jurisdiction (Labor Law casebook, 2004). Second, it is important to note that the U.S. does not have a unified inspection regime like that of Korea. The number of bodies and overlapping legislation in the US has created jurisdictional issues and confusion. Additionally, enforcement is lacking even with all the agencies that have been created. Finally, even if these issues were settled, the probability of significantly more agencies being created by the government of Canada is not realistic. (Queen's University (CCPA/CSchE), 2009)

In Canada, regulating the management of process safety creates a different challenge. As highlighted by the discussion in Section 3 of this summary, many of the regulations required to address process safety management already exist together with responsible regulatory agencies. The key will be identifying the regulatory gaps and overlaps to ensure problem areas are targeted and a cohesive enforcement strategy developed. Each of these regulators is considering how to better incorporate PSM concepts into their regulatory practices. A joint regulator - industry dialog will be critical to ensure the success of these efforts.

Goal-oriented regulations are an attractive and preferred regulatory framework for both the regulators and industry. It provides flexibility where the requirements cannot be totally prescribed because of the complexity of the processes or systems dealt with. It gives the industry the opportunity to define the state-of-the-art and its quick evolution in particular when innovation is a driver in some industry sectors. The role of the regulators is a role of endorsement of the best practices.
and control of implementation. When a goal-orientated regulation is accompanied with agreed guidance documents or norms, it helps the industry operators to demonstrate to the authorities the conformity with the regulations.  

3.2 Integrated Management System Approach

As evidenced in the studies of major accidents, the consistent, effective implementation of a management system is a significant challenge. As noted by the NEB in their discussion paper on Emerging Issues in Oil and Gas Industry Safety Management (NEB, 2013), effective management systems are:

- **Consistently applied**: The system elements are applied consistently across operational programs (worker safety, asset integrity, damage prevention, environmental protection, and emergency management), facilities and geographic regions.

- **Highly integrated**: There are multiple interdependencies between management system elements and so the management system is designed to share information and intelligence to promote better decisions. Input is sought from all programs and functions (i.e., human resources and finance) in planning processes such as hazard identification and risk assessment. The organization collects, tests, and verifies information from across the organization to confirm compliance with organizational policies and standards as well as regulatory requirements.

- **Assign accountability**: All officers and employees have a role to play in meeting the safety, security and environmental protection goals of the organization. These responsibilities must be clearly assigned and communicated. Performance must be measured and improvement required.

This integrated approach to managing process safety needs to go beyond company-specific management systems to be effective. Consideration needs to be given to how the systems of those working together to accomplish a mutual goal and the thinking needed to ensure the alignment of the required processes as highlighted by the figure below.

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3.3 Recommendations for PSM System Elements

It is important to develop an effective Management System that integrates operations and technical systems with the management of occupational health, safety and environmental protection and process safety to ensure compliance with OHS Acts and Regulations. The table included in Section 1 reinforces that getting agreement on the exact number and nature of PSM elements is improbable and, in fact, is not that important - the intended objectives are.

The Management System should correspond to the size, nature and complexity of the operations and activities, hazards and risks associated with the operations. System documentation should be controlled and set out in a logical and systematic fashion to allow for ease of understanding and efficient implementation.

Regardless of size and complexity, the key principles to be considered when developing a process safety management program include: (Krause, 2011)

- **Interdependent continuity of operations, systems and organization.** This includes issues related to personal safety, process safety and project management and their relationship.
- **Management of information.** The process safety management program relies upon providing availability and access to good records and documentation.
- **Control of process quality, deviations and exceptions and alternate methods**
- **Management and supervisory accessibility and communications.** Because process safety management is the basis for many of the safety efforts within a facility, managerial, supervisory and employee responsibility and accountability should be clearly delineated, communicated and understood in order for the program to work effectively.
- **Goals and objectives, compliance audits and performance measurement.** Prior to implementation, it is important to establish both long-term and short-term goals and objectives for each of the elements of the process safety management program.

The management system will need to consider the following process safety objectives:

- Establish process safety policy and engage key stakeholders.
- Confirm compliance with the technical safety requirements applicable to the planned operations.
• Obtain and maintain relevant knowledge and information to the planned work scope.
• Identify hazards and assess operational risk. Establish the barriers and controls required to prevent loss of primary containment.
• Develop the required operational plans, well programs and work procedures.
• Obtain (quality) supplies and retain (competent) services required to complete planned operations.
• Communicate work requirements, plans and practices as required for competent performance.
• Identify safety critical components, inspect and maintain as required to confirm integrity.
• Establish and test emergency equipment and procedures in the event of a loss of primary containment event as required to mitigate the consequences of a loss of primary containment.
• Conduct operation readiness reviews before commencing operations (Includes final pre-startup review procedures).
• Establish procedures for monitoring and controlling work including site handover procedures, permit-to-work systems, simultaneous operations.
• Manage technical and personnel changes during the course of operations.
• Learn from any incidents and apply changes to prevent reoccurrence.
• Conduct regular reviews of operations to confirm system effectiveness and improve as required. (Includes on-the-job observations for process safety behaviours.

An integrated management system that addresses these objective, together with operational discipline, will result in safe and reliable operations and compliance with the occupational health and safety, technical and energy regulations that apply to the planned works.

In this regards a useful reference is the ILO Code of Practice for “Prevention of Major Industrial Accidents”, which provides a comprehensive objective-based framework.

3.4 Measuring and Reporting Industry Performance

Analysis of past incidents reveals that inadequate leadership and poor organizational culture have been recurrent features (OECD, 2012). This includes:

• a failure to recognize things were out of control (or potentially out of control), often due to lack of competence at different levels of the organization
• an absence of, or inadequate, information on which to base strategic decisions – including the monitoring of safety performance indicators at a company’s Board of Directors level
• a failure to understand the full consequences of changes, including organizational change
• a failure to manage process safety effectively and take the necessary actions

As noted by the NEB in their Emerging Issues Forum (NEB, 2013), many high hazard industries define and measure the safety of their operations as occupational health
and safety of individual workers. This approach to safety performance measurement has principally two short-comings:

1) It places an disproportionate amount of attention on personal safety hazards such as “slip, trip, and fall” hazards, which may limit awareness of other process and project hazards and risks that need to be managed in order to protect the public and the environment.
2) It is one-dimensional and provides an incomplete and inaccurate account of the overall level of safety of an activity, a facility or organization.

To get a more complete picture of safety performance, regulators and companies must look beyond traditional lagging safety measurements such as total recordable injury rates, and look to a combination of leading and lagging process safety performance measures that provide a complete view of their organization’s current state of safety in order to identify areas of weakness and to proactively manage safety in advance of an incident.

This has been identified by CAPP as a priority issue.

There are a number of world-wide initiatives targeted at the issue of process safety performance measurement. Documents which CAPP utilizes as a benchmark to establish a foundation for improved performance measurement for the Canadian upstream oil and gas industry include:

- OGP’s Process Safety Performance Indicators For The Refining And Petrochemical Industries

Ultimately the driver behind measuring and reporting is entrenched in stakeholder engagement. CCPS’s Vision 2020 is

A call to action for all of society - our leaders, our governments; the public at large — to be passionate about protecting people and property and, to accept no less than stakeholder knowledge, responsible collaboration, harmonization of standards and meticulous verification in matters of process safety.
CCPS’s Vision 2020 \(^{26}\) outlines four societal themes which are worth highlighting in this regulatory scan:

- **Enhanced Stakeholder Knowledge** for all stakeholders, beginning with the public. Just as the public must challenge industry through means of meticulous verification, industry must likewise challenge the public to engage in science, technology, engineering and mathematics (STEM) education, and push for risk literacy in middle or high school, so that students are prepared to absorb more technical concepts in business and engineering schools.
- **Responsible Collaboration** between government regulatory and investigative authorities, labour organizations, communities, research institutions, universities and industries working together to remove legal barriers to reporting incidents, develop reporting databases and promote mutual understanding of risks and effective process safety systems.
- **Harmonization of Standards** by organizations that produce guidelines for the safe design, operation and maintenance of equipment, to streamline practices, eliminate redundancy and cooperatively address emerging issues. If standard writing organizations work together, in the same spirit that the Center for Chemical Process Safety is working with other global and national organizations to harmonize process safety metrics, the resulting standards will provide significant guidance for improved process safety.
- **Meticulous Verification**, from knowledgeable third parties, including public or non-governmental organizations, to help companies evaluate their process safety programs from the outside-in. Today, most companies conduct these audits internally. By 2020, it will be standard practice to bring in an accepted third party to ensure a company’s process safety systems are robust and functioning as intended.

### 3.5 The Business Case for Process Safety \(^{(CCPS, 2006)}\)

*If you think safety is expensive, try having an accident.*

In 2006, the CCPS issued a document titled: "The Business Case for Process Safety" \(^{27}\). To summarize the key points, CCPS noted four benefits:

1) **Qualitative Benefits**
   - **Corporate Responsibility**: Process safety helps your company display corporate responsibility through its actions. The heart of process safety lies in consistently planning to do the right things, then doing them right - consistently. Corporate responsibility leads to the second benefit…
   - **Business Flexibility**: Corporate responsibility as demonstrated in your process safety management program leads to a greater range of business flexibility. When you openly display responsibility through implementing an effective process safety program, your company can achieve greater freedom and self-determination.


2) Quantitative Benefits

- **Risk Reduction**: A healthy process safety program significantly reduces the risk of catastrophic events and helps prevent the likelihood of human injury, environmental damage, and associated costs that arise from incidents. Although the essence of process safety focuses on preventing catastrophic incidents, the number of less severe incidents is also reduced.

- **Sustained Value**: Process safety relates directly to enhance shareholder value. When properly implemented, it helps ensure reliable processes that can produce high quality products, on time, and at lower cost. These improvements allow the enterprises that make them to sustain value creation over time.

A link to the CCPS document is included in Appendix B.

3.6 **Emphasis on Risk Control Measures**

The OECD has developed guidance on corporate governance for safety in high hazard industries. These guidelines recommend that senior corporate leadership play an *active* role in how the organization manages safety risks. This guidance was referenced by the NEB in their forum on ‘Emerging Issues in the Oil and Gas Industry Safety Management’ [28].

In providing guidance, the OECD emphasizes that leaders need to understand the risks posed by their organization’s activities, and balance major accident risks alongside the other business threats. (OECD, 2012) Even though major accidents occur infrequently, the potential consequences are so high that leaders need to recognize:

- major accidents are a credible business and financial risk,
- the potential for supply chain disruption and associated costs, and
- management of process safety risks should have equal focus with other business processes including financial governance, markets, and investment decisions, etc.

A link to the OECD document is included in Appendix B.

Other observations relevant to risk management:

- Do not confuse the business risk with the OHS/PSM risk. In many cases, the business risk can be mitigated by insurance. The OHS/PSM risk can only be addressed by concrete measures to eliminate or control the hazard and the physical risk to workers, the public and the environment.
- Public perception has many times driven the promulgation of reactive regulations that have significantly increased business costs without creating any meaningful improvement in industry performance further eroding the credibility of both our industry and the responsible regulators.

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Risk assessment lies at the heart of every process safety management standard. A powerful and increasingly popular risk assessment technique is the ‘bow-tie’ analysis, so called because it describes the management of risk in the shape of a bow-tie. This method goes beyond other risk assessment methods by highlighting the controls and barriers established to prevent a hazardous energy release. It thus can help to ensure that risks are truly managed, rather than just analyzed. It forces practitioners into undertaking a comprehensive and structured approach. It is an excellent means of communicating risk issues to non-specialists.

3.7 The Last Word: Creating a Balanced Safety Culture

Safety culture is the key driver of safety and management systems are the tool in which safety and environmental protection can be achieved. An emphasis on safety culture is a critical dimension of the NEB’s safety initiatives.

In December 2011, the NEB invited Dr. Mark Fleming of Saint Mary’s University to speak during a community outreach initiative in Inuvik related to offshore drilling. In his report, Safety Culture Review Implications for Regulators, Dr. Fleming cites four common cultural factors identified in inquiry reports from 17 major disasters, including the offshore disasters Piper Alpha, Ocean Ranger, and Deepwater Horizon. These include:

- Tolerance of Inadequate Systems And Resources: Front-line employees are willing to tolerate poor systems, maintenance or inadequate resources
- Deviation from Safety Policy Becomes Normal and Accepted: Employees accept that not everyone will follow the rules laid out in organizational policy, or that the rules do not necessarily need to be followed in order to operate safely
- Complacency: Major disasters are rare, though catastrophic. Because they do not happen frequently, employees and management begin to feel that they simply will not happen, no matter how high-hazard daily operations may be
- Work Pressure: The pressure to meet deadlines or cut costs can overwhelm the desire or directive to follow procedures, take precautions, or even stop work if something does not appear to be right

There is a growing amount of attention being focused on safety culture including seminal work by Dan Peterson and James Reason. CCPS’s Vision 2020 published in 2013, outlines five core tenants needed to drive performance improvement and achieve great process safety performance. These are worth repeating to conclude this regulatory scan:

1) A Committed Culture in which the executives are personally involved, managers drive excellent execution every day and all employees maintain a sense of vigilance and vulnerability. To create a committed culture, leadership
must tangibly demonstrate a commitment to process safety from the senior executive team through its line management, so that all employees embrace it and recognize that “it could happen here.”

2) Vibrant Management Systems engrained throughout the organization. For vibrant management systems to be effective, all employees must have a clear understanding of the expectations of senior management, and those expectations must be documented and shared to promote safer design principles in accordance with fit-for-purpose policies and procedures.

3) Disciplined Adherence to Standards for new and existing equipment to minimize opportunities for error in design, operation, and maintenance. While new construction may be the primary consideration when considering process safety standards, ensuring that existing equipment meets company expectations can be even more important. By the year 2020, companies should have requirements that ensure aging equipment adheres to evolving standards, while working cooperatively with regulators to make standards effective and efficient.

4) Intentional Competency Development to ensure that all employees who impact process safety are fully capable of meeting the technical and cultural requirements for their jobs. The bottom line: no matter how good the culture or management system is, or how well the company adheres to standards, it takes highly competent employees to implement those systems or standards. And that requires intentional competency development.

5) Enhanced Application and Sharing of Lessons Learned, including an expectation and thirst for learning from several different types of opportunities. To reduce incidents, employers and employees must enthusiastically support a culture that is driven to learn from many sources, including benchmarking, near misses, and incidents, and jobs done well. The ability to rapidly share lessons learned and use those lessons to drive procedural or mechanical change across companies and industries is key to improving process safety performance.

Figure 3-1 CCPS Vision 2020

http://www.aiche.org/sites/default/files/docs/pages/vision2020.pdf Note: link is provided in Appendix B.
3.8 CAPP 5-Year Process Safety Strategic Plan

In consideration of the prior learnings and recommendations, CAPP is in the process of working with the other upstream industry associations and regulators to develop a 5-year strategic plan.

This plan is comprised of the following four elements:
1) Establish Objectives
2) Identify Performance Measures
3) Establish Improvement Targets
4) Implement Industry Process Safety Initiatives

These are summarized in more detail in the following figure.

![Figure 3-2 CAPP PSM 5-year Strategic Plan Framework (Draft)](image-url)
Appendix A  List of Acronyms
A.1 Acronyms Used in Regulatory Scan

- ABSA Alberta Boiler Safety Association
- ACC American Chemistry Council (Formerly the Chemical Manufacturers Association)
- AER Alberta Energy Regulator (Formerly EUB - Energy Utilities Board and ERCB – Energy Resources Conservation Board)
- AFPN American Fuel & Petrochemical Manufacturers (formerly the National Petrochemical & Refiners Association)
- AIChE American Institute of Chemical Engineers
- ANSI American National Standards Institute
- API American Petroleum Institute
- BCSA British Columbia Safety Authority
- BSSE Bureau of Safety and Environmental Enforcement
- CAFC Canadian Association of Fire Chiefs
- CAGC Canadian Association of Geophysical Contractors
- CAODC Canadian Association of Oilwell Drilling Contractors
- CAPP Canadian Association of Petroleum Producers
- CDC Center for Disease Control and Prevention
- CCME Canadian Council of the Ministers of the Environment
- CEPA Canadian Environmental Protection Act
- CEPA Canadian Energy Pipeline Association
- CFR Code of Federal Regulation
- CIAC Chemistry Industry Association of Canada
- CIMAH Control of Industrial Major Accident Hazards Regulations
- COMAH Control of Major Accident Hazards Regulations
- CCPS Center for Chemical Process Safety
- CIAC Chemical Industry Association of Canada
- CSA Canadian Standards Association
- CSB US Chemical Safety and Hazard Investigation Board
- CSChE Canadian Society for Chemical Engineering (Formerly the Chemical Institute of Canada)
- DACC Drilling and Completion Committee
- DOT US Department of Transportation
- EI Energy Institute
- EPA US Environmental Protection Agency
- EPAC Explorers and Producers Association of Canada (Formerly SEPAC)
- GHS Global Harmonized System of Classification and Labeling of Chemicals
- HSE Health and Safety Executive (United Kingdom)
- IADC International Association of Drilling Contractors
- ICCA International Council of Chemical Associations
- ILO International Labour Organization
- ISO International Organization for Standardization
- LRWS Saskatchewan Labour Relations and Workplace Safety
- MIACC  Major Industrial Accident Council of Canada
- NEB  National Energy Board
- NIOSH  National Institute for Occupational Safety and Health
- NTSB  US National Transportation Safety Board
- OECD  Organization for Economic Co-operation and Development
- OGC  British Columbia Oil and Gas Commission
- OGP  International Association of Oil & Gas Producers
- ORSEC  d'Organisation de la Réponse de Sécurité Civile (France)
- OSHA  US Occupational Safety and Health Administration
- PSM  Process Safety Management
- PSAC  Petroleum Services Association of Canada
- PSR  Process Safety Regulation
- REACH  EU Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation
- RMP  Risk Management Program (US EPA)
- SCC  Standards Council of Canada
- Also Alberta Safety Codes Council
- SER  Saskatchewan Energy and Resources
- SEMS  Safety and Environmental Management System
- TDG  Transportation of Dangerous Goods
- TSB  Transportation Safety Board of Canada
- TSASK  Technical Safety Authority of Saskatchewan
- USCG  US Coast Guard
- WHMIS  Workplace Hazardous Materials Information System
Appendix B  Resources
B.1 Resources


Technology, Engineering and Management (TEAM), Department of Chemical Engineering at Queen’s University, 2009. The Control Of Major Accident Hazards In Canada. team.appsci.queensu.ca/documents/CSChE_ControlMajorAccidentHazardaCanada_Report.v4.pdf.


