

A Canadian Perspective of the History of Process Safety Management Legislation

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Abstract

In the broadest sense of historical context, there have been two seminal incidents that have forever shaped society's approach to the prevention and mitigation of process risk, and the protection of people, assets, and the environment – Flixborough, UK (1974) and Bhopal, India (1984). Canadian incidents, such as Westray (1992), have influenced Canada's approach to the issue. Finally, the 9/11 terror attacks on New York's World Trade Center (2001) also prompted societal rethinking of chemical and process plant risks. In taking a world-view of the evolution of the field of Process Safety Management legislation, it becomes evident that society and government attitudes, expectations of corporations, and those that manage and work in them have changed. Canada's approach to industry to date has been predominantly consultative and performance based. However, while our overall industrial safety record has been acceptable, care must be taken by Canadian industry to keep our plants operating safely or face the prescriptive legislative approach experienced in the US and Europe.

Introduction

Change often occurs as the result of catastrophes. In the development of what has become known as the field of Process Safety Management or PSM, this certainly appears to be the case. By examining the history of industrial disasters and the world's response to them, certain patterns emerge. If the disaster is catastrophic enough and significantly inconveniences or hurts the public, society often responds by taking legislative action. Unfortunately, such action is typically not fast in coming, as it must be discussed with many stakeholders, including government, industry and the public.

The current legislative environment of Canada is quite unique in the Western world, as it has generally been viewed as a "performance based" approach. Performance based standards focus on what must be done, rather than on how it should be done. The

difference between performance based and the more traditional prescriptive standard is that performance based standards concentrate on the result, while prescriptive standards set out details of the process, which may or may not achieve the desired results.

In the year 1780 B.C., Hammurabi's code of laws in ancient Mesopotamia contained punishments based on a peculiar "harm analogy." Law 229 of this code states; "If a builder builds a house for some one, and does not construct it properly, and the house which he built falls in and kills its owner, then that builder shall be put to death." Hammurabi's public declaration to his people of an entire body of laws in order that all might read and know what was required of them might be the earliest example of a performance based standard.

In comparison, "prescriptive" standards are based on the premise of instructing the responsible person exactly what action to take. Very specific rules must be followed in order to comply with the standard. An ancient example of this comes from the Old Testament book of Deuteronomy Chapter 22, Verse 8, which states; "When you build a new house, you shall make a parapet for your roof, that you may bring the guilt of blood upon your house, if anyone fall from it." ¹

From 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.

Definitions

Process means any activity involving highly hazardous chemicals including any use, storage, manufacturing, handling, or the on-site movement of such chemicals, or a combination of these activities.²

Process Safety is a blend of engineering and management skills focused on preventing catastrophic accidents, particularly explosions, fires, and toxic releases, associated with the use of chemicals and petroleum products.³

Process Safety Management—also referred to as PSM—is the application of management systems to the identification, understanding and control of process hazards to prevent process-related injuries and incidents.⁴ The goal is to minimize process incidents by

evaluating the whole process. The phrase Process Safety Management came into widespread use after the adoption of OSHA Standard 29 CFR 1910.119 *Process Safety Management of Highly Hazardous Chemicals* in 1992.

Process industries are typically involved in changing by chemical, physical or other means, raw materials into intermediate or end products. They include gas, oil, metals, minerals, chemicals, pharmaceuticals, fibers, textiles, food, drinks, leather, paper, rubber and plastics. Energy, water, contracting and construction are also included.⁵

Occupational Health and Safety (OH&S), as defined by the World Health Organization, is considered to be multi-disciplinary activity aiming at the:

- Protection and promotion of the health of workers by preventing and controlling occupational diseases and accidents and by eliminating occupational factors and conditions hazardous to health and safety at work;
- Development and promotion of healthy and safe work, work environments and work organizations;
- Enhancement of physical, mental and social well-being of workers and support for the development and maintenance of their working capacity, as well as professional and social development at work;
- Enabling workers to conduct socially and economically productive lives and to contribute positively to sustainable development.⁶

OH&S codes and standards do not specifically address issues related to Process Safety. In part, this is because OH&S risks are typically of higher frequency and lower consequence than process risks. Indeed, their focus is different (see Table 1).

Table 1
 Difference between Focus of OH&S and PSM

	Occupational Health & Safety	Process Safety Management
Focus	Eliminate harm to people, assets and the environment	Eliminate process related incidents

Standard is a basis for comparison or a reference point against which other things can be evaluated. When it comes to the guidelines which govern the areas of OH&S and Process Safety Management, they are often referred to as standards.

A formal definition of “standard” comes from ISO, the International Organization for Standardization. ISO defines a standard as “a documented agreement containing technical specifications or other precise criteria to be used consistently as rules,

guidelines, or definitions of characteristics to ensure that materials, products, processes and services are fit for their purpose. It is a living agreement.⁷ There are different levels of standards (see Table 2).

Table 2
 Levels of Standards

Standard	Geographic Focus	Example
International	Global – one worldwide standard	IEC 61511 / ISA S84; ISO 9000
Regional	Countries in close proximity	CANAMEX Truck Standard - NAFTA
National	Country – minimum standard within nation	CSA (Can.) OSHA (US); HSE (UK)
Industrial	Country - minimum standard within industry	ASME, API
Company	Wherever the corporation operates	Shell, Petro-Canada, Cameco

Early History

Early in the 20th century—as industrialization and technology progressed—the pattern of intermittent catastrophes began to make its appearance. In 1921, at the BASF plant in Oppau, Germany, explosions destroyed the plant, killing at least 430 people and damaging approximately 700 houses nearby. The explosions occurred as blasting powder was being used to break-up the storage pile of a 50/50 mixture of ammonium sulfate and ammonium nitrate. This procedure had previously been used 16,000 times without any mishap.

In 1947, a fire and explosion in Texas City, Texas on the Monsanto Chemical Company's S.S. Grandcamp while loading ammonium nitrate fertilizer killed over 430 people. There was no specific legislative response to these incidents.

Interestingly, the United States Center for Chemical Process Safety (CCPS), which provides leadership and infrastructure to promote and advance PSM, suggests Process Safety was born on the banks of the Brandywine River in the early days of the 19th century at the E. I. du Pont black powder works. Recognizing that even a small incident could precipitate considerable damage and loss of life, du Pont directed the works to be built and operated under very specific safety conditions.⁸

However, it is probably the Flixborough (1974) disaster that most regard as the beginning of what is now called Process Safety Management.

Process Incidents and Legislative Response

By reviewing significant industry and process related incidents and the legislative responses, it becomes evident that society and government attitudes and expectations of corporations and those that manage and work in them have changed.

Europe & Asia

- Flixborough UK (1974)—A fire and explosion at a Nypro UK chemical plant in the village of Flixborough killed 27 workers and resulted in a fire that blazed for 10 days. It was Britain's biggest peacetime explosion and had it occurred during a week day, estimates are that over 500 people would have been killed. The investigation which followed the explosion found major flaws with the plant's design.
- Seveso, Italy (1976)—A fire and explosion at a small chemical manufacturing plant, approximately 25 km north of Milan, owned by ICMESA, resulted in the release of what are commonly called dioxins. The vapour cloud forced the evacuation of nearby towns, poisoned as many as 2,000 people and contaminated some 10 square miles of the surrounding area.

Response: The massive and widespread public outcry over industrial plant safety 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.

- Bhopal, India (1984)—A release of insecticide and pesticide at a Union Carbide plant killed more than 3,800 people and caused respiratory and eye damage to over 20,000 others. It forced the evacuation of more than 200,000 people from the city. It is widely considered to be the world's worst industrial accident.
- Piper Alpha, UK (1988)—An explosion and fire on the Piper Alpha offshore platform, owned by Occidental Petroleum, in the North Sea resulted in the deaths of 165 and the loss of the complete installation.

Response: Lord Cullen's report—what is often referred to as the world's worst offshore oil disaster in terms of lives lost and impact to industry—made 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.

- Basel, Switzerland (1986)—When a fire broke out at the Sandoz chemical plant near Basel, the water that firefighters used to put out the blaze flushed huge amounts of insecticide and pesticide into the nearby Rhine River, turning it red, sparking an ecological catastrophe. Since Basel was high up in the river basin, all the downstream countries became polluted and their drinking water supplies contaminated.

Response: While Switzerland was not a member of the European Community, the affected population and their representatives demanded that manufacturers take much tougher action against pollution. The Seveso Directive was adapted to accommodate additional requirements for preventing environmental damage.

- Chernobyl, USSR (1986)—A plume of highly radioactive dust, estimated at over 30 times the amount released after the Hiroshima atomic blast in World War II, drifted over parts of the Soviet Union, Europe and eastern North America after the explosion and fire at the nuclear power plant. It resulted in the evacuation and resettlement of over 336,000 people and deaths of thousands.
- Toulouse, France (2001)—An explosion at the AZF fertilizer factory, in a suburb of Toulouse, killed 30 people and initially was feared to be the work of terrorists.

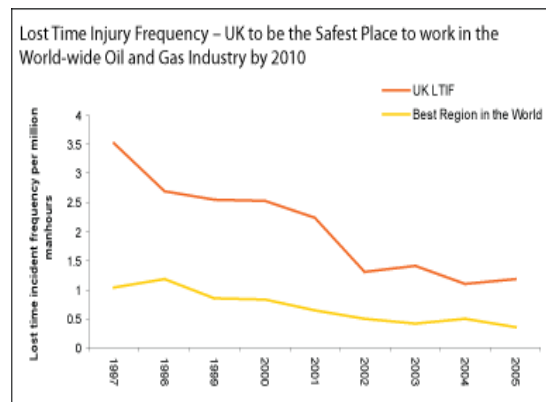
Response: The Seveso II Directive was modified to integrate two new categories of fertilizer. In France, there were changes in land use planning.

- Hertfordshire, UK (2005)—The oil storage terminal, generally known as the Buncefield Depot, suffered a series of explosions which surpassed the ferocity of the Flixborough incident, and has been described as the biggest of its kind in peacetime Europe.

Response: The initial investigation to the UK's Health and Safety Commission and the Environment Agency draws broad conclusions about the need for action in three areas: design and operation of storage sites; emergency response to incidents; advice to planning authorities. Legislative change is still pending.

So what has all this regulation and legislation accomplished? Is European industry "safer"? The chart below shows the safety performance of the UK oil and gas industry, compared to the best region in the world since 1997, in terms of the frequency of all reported injuries (including fatalities).

The chart indicates that there has been a significant fall in the Lost Time Injury Frequency Rate for the UK since 1997.⁹



With respect to OH&S incidents, it would appear that in the UK there has indeed been progress.

Australia

- Longford (1998) —The explosion at an Esso gas plant killed two workers and resulted in the state of Victoria's entire gas supply being shut down. The crisis devastated the state's economy and since natural gas was widely used residentially in Victoria, resulted in Victorians enduring 20 days of cold showers and chilly nights.

Response: 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 Esso 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. They follow the Safety Case regime developed in the UK following Piper Alpha.

Canada

Canada has suffered relatively few catastrophic industrial incidents in its history.

- Ocean Ranger (1982)—The largest drilling rig in the world at the time capsized off the coast of Newfoundland with the loss of 84 lives. It is the worst offshore drilling accident in Canadian history.

Response: 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 of development. These regulations govern the necessary requirements of offshore safety. They are prescriptive.

- Westray (1992)—A spark deep in the Westray mine in Nova Scotia ignited an invisible cloud of methane gas, triggering a massive explosion that trapped and killed 26 workers. Despite the magnitude of the loss and the organization's disregard for the safety and welfare of their workers, neither the corporation nor any individual was convicted of criminal negligence or an Occupational Health and Safety offence.

Response: On March 31, 2004, nearly 12 years after the incident, 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.

❖ How Canada is Unique

In Canada, 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 (i.e. railroads, federal employees). Labour Canada has no authority whatsoever in almost all process industry plants, which fall under the jurisdiction of the province.¹⁰

In fact, 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.

❖ **The Canadian Response**

The disaster in Flixborough, UK (1974) was a wake up call to the world's industrial leaders and Canadian industry was no exception. Formal and informal meetings and discussions within the chemical industry, in particular, created a mindset of following best practices to prevent and mitigate risk.

The Canadian Chemical Producers Association (CCPA), who had developed a unique "ethic" for the safe and environmentally sound management of chemicals in the late 1970's, before Bhopal, launched the Responsible Care® initiative in 1985. Responsible Care® is a real Canadian success story. In fact, Responsible Care® is the world's leading voluntary industry initiative - it is run in 53 countries whose combined chemical industries account for nearly 90% of global chemicals production. ¹¹



Graphic 1
Safety Partner Triangle

Every national Responsible Care® program has eight fundamental features ¹²:

- A formal commitment by each company to a set of guiding principles - signed, in most cases, by the Chief Executive Officer.
- A series of codes, guidance notes and checklists to help companies fulfill their commitment.

- The development of indicators against which improvements in performance can be measured.
- Open communication on health, safety and environmental matters with interested parties, both inside and outside the industry.
- Opportunities for companies to share views and exchange experiences on implementing Responsible Care®.
- Consideration of how best to encourage all member companies to commit themselves to, and participate in, Responsible Care®.
- A title and logo which clearly identify national programs as being consistent with, and part of, the Responsible Care® concept.
- Procedures for verifying that member companies have implemented the measurable or practical elements of Responsible Care®.

Canada also responded to Bhopal by creating the Major Industrial Accident Council of Canada (MIACC) in 1987 (later disbanded in 1999). 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.

The partnership philosophy between industry, government, and the public was key to how Canada evolved in the 1980's and 1990's – post Bhopal. In fact, until 2001, Canada was unusual among the world's industrialized countries in having very little in the way of legislation and regulation controlling major accident hazards in the process industries.¹³

Since 2001, federal and provincial governments have passed legislation that raises the expectation of how corporations and those that manage and work in them.

❖ **Canadian Environmental Protection Act (2000)**

The Canadian Environmental Protection Act (CEPA), 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.

❖ **Quebec Civil Protection Act (2001)**

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.

❖ **Ontario Emergency Management Act (2003)**

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

❖ **Bill C-45 (2004)**

As highlighted earlier, the “Westray” Bill, as it is known, amends the Criminal Code of Canada to extend the liability of companies in the area of health and safety. There has also been a successful prosecution.

On December 7, 2007, Transpavé Inc., a Québec paving stone manufacturer, became the first organization to be convicted of criminal negligence causing death. The case involved an event in October 2005, whereby a 23 year old employee of Transpavé was fatally injured after moving into an area where a machine was apparently jammed. The equipment was equipped with a light-beam or curtain guarding system that was intended to stop the operation of the machine if the light beam/curtain was broken. However, the safeguarding systems were often bypassed and the worker was fatally injured.

On March 17, 2008, the Quebec court formally accepted the joint recommendation of the Crown and the Defence and fined Transpavé \$100,000. Pursuant to section 737 of the *Criminal Code*, Transpavé will also have to pay an additional victim surcharge of \$10,000 which will go towards provincial programs designed to assist victims of criminal and regulatory offences.

In imposing the fine, Judge Chevalier noted that since the crime, Transpavé had spent half a million dollars to bring its plant up to European safety standards, higher than the prevailing North American standards.

The impact of a conviction using Bill C-45 will be significant. A precedent has been established. Following an incident, companies will have a legal requirement to demonstrate that the measures taken to prevent the incident from occurring were reasonable and that the circumstances which led to the incident were extremely unusual and could not have been foreseen and therefore prevented. It also highlights the importance of documentation. Records of current and accurate operating and maintenance procedures and up-to-date worker training, for example, may either help or hurt companies should incidents occur.

United States

- Cleveland (1970)—The Cuyahoga River, which runs through Cleveland, Ohio, caught fire in June 1969. This river fire captured the attention of *Time* magazine, which described the Cuyahoga as the river that "oozes rather than flows" and where a person "does not drown but decays".

Response: The 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.

- Three Mile Island (1979)—The civilian nuclear power plant located in Pennsylvania suffered a partial meltdown and is the site of the worst civilian nuclear accident in United States history.
- Niagara Falls (1980) —Chemicals from toxic waste buried in a former Hooker Chemical landfill site in Niagara Falls, New York, nicknamed "Love Canal", leached into basements and evaporated into the household air of nearby residents and caused severe health problems.

Response: In response to the Love Canal disaster, the United States environmental law officially known as the Comprehensive Environmental Response, Compensation, and Liability Act was enacted. Also known as the "Superfund", the law paid for toxic waste cleanups at sites where no other responsible parties could pay for a cleanup by assessing a tax on petroleum and chemical industries.

- Institute (1985)— A large inadvertent release occurred from a Union Carbide plant in West Virginia. While no fatalities resulted, an investigation concluded that Union Carbide had double standards when operating its plant in India and West Virginia. "While the latter plant had computerized warning and monitoring system, the former relied on manual gauges and the human senses to detect gas leaks. The capacity of the storage tanks, gas scrubbers, and flare tower was greater at the Institute plant. Finally, emergency evacuation plans were in place in Institute, but nonexistent in Bhopal." ¹⁴
- Pasadena (1989) – A series of fires and explosions, resulting in a “mushroom cloud”, at the Phillips 66 polyethylene plant in Pasadena, a suburb of Houston, killed 23 workers.
- Channelview (1990) – Only nine months after Pasadena, a deadly blast ripped through the ARCO Chemical Co. plant in Texas, killing 17 workers.

Response: In 1990, the U.S. Department of Labour 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 (HHC)*.

- OPA (1990) - The Oil Pollution Act was signed into law largely in response to rising public concern following the Exxon Valdez incident, in which over 10 million gallons of oil were spilled into Alaska’s Prince William Sound on March 1989. The goal was to prevent further oil spills from occurring in the United States.

❖ **The US Response : Community Awareness & Emergency Response (1985)**

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, designed by the Chemical Manufacturers Association (CMA) to improve emergency response planning in communities near chemical facilities. ¹⁶ It provided a set of guiding principles for managing chemical producers’ environment, safety, and health obligations. In 1988, U.S. members of the Chemical Manufacturers Association (CMA) adopted the core Responsible Care® guidelines from Canada, and made them mandatory for CMA members in the US.

❖ **Emergency Planning and Community Right-to-Know Act (1986)**

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 (EPCRA).

❖ **Clean Air Act Amendments (1990)**

The Clean Air Act (CAA) Amendments of 1990 authorized both EPA's Risk Management Program, and OSHA's Process Safety Management standard. OSHA was mandated by Section 304 of the CAA to develop chemical accident prevention and emergency response regulations to protect workers at hazardous chemical facilities.

❖ **Process Safety Management Standard (1992)**

OSHA's Process Safety Management standard (29 CFR Part 1910), which focused on worker safety, placed accident prevention and emergency response requirements on facilities having specified hazardous chemicals above certain threshold quantities.

❖ **The U.S. Chemical Safety and Hazard Investigation Board (1998)**

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

❖ **Risk Management Program (1999)**

Focused on community safety, the Risk Management Program regulations (40 CFR Part 68) are similar to OSHA's PSM standard. They cover many of the same toxic and flammable chemical substances, and require a similar set of accident prevention requirements. 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.¹⁸

❖ **Public Health Security and Bioterrorism Preparedness and Response Act (2002)**

Since September 11, 2001, the US federal government passed the Act to improve the ability of the United States to prevent, prepare for, and respond to bioterrorism and other public health emergencies. It requires larger community water utilities (many of which use large quantities of hazardous chemicals such as chlorine, sulfur dioxide, and ammonia) to conduct security vulnerability assessments.

❖ **Maritime Transportation Security Act (2004)**

This Act is designed to protect US ports and waterways from a terrorist attack. It requires vessels and port facilities to conduct vulnerability assessments.

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) and Nevada's Chemical Catastrophes Prevention Act (1991). Industry groups have spawned industry standards also, such as the American Institute of Chemical Engineers (AIChE) Center for Chemical Process Safety (1985) and the American Petroleum Institute Recommended Practice 750 - Management of Process Hazards (1990).

OSHA Recognition of IEC 61511

In Canada and the United States, one of the most significant developments which has occurred recently was the acceptance and recognition of OSHA that the IEC 61511 *Functional safety - Safety instrumented systems for the process industry sector* Standard represents good engineering practice.

A November 2005 letter from OSHA to ISA (Instrumentation, Systems, and Automation) Society stated:

“OSHA considers the revised ANSI/ISA – S84.00.01 – 2004 Parts 1 – 3 (IEC 61511 Mod) to be recognized and generally accepted good engineering practices for SIS. Therefore, if an employer chooses to use S84.00.01 – 2004 Parts 1 – 3 as a basis (“code or standard employed” for SIS, and meets all S94.00.01 2004 Parts 1 – 3 requirements related to SIS, the employer will then be consider in compliance with OSHA PSM requirement for SIS”.

Table 3 outlines the chronology of significant process industry incidents and legislative responses by various countries since the Flixborough disaster of 1974.

Table 3
 Significant Process Industry Incidents and Responses in Last 35 years

Location of Accident	Year	Incident	Regulatory Response
Flixborough UK	1974	Explosion and fire, 27 killed, over 100 injured	CIMAH (1984) COMAH (today)
Seveso, Italy	1976	Dioxin release, 2,000 poisoned, environmentalcontamination, mass evacuation	Seveso Directive (1982)
Newfoundland Canada	1982	Ocean Ranger lost, 84 dead	Changes to Atlantic Accord Acts
Bhopal, India	1984	3,800 people killed, 20,000 Injured, 200,000 evacuated	CAER Program (1985)
Institute, USA	1985	Toxic gas release - no fatalities, but happened just after Bhopal	Emergency Planning and Community Right to Know (1986)
Basel Switzerland	1986	Rhine river contamination, severe environmental damage	Changes in Seveso Directive
North Sea, UK	1988	165 killed, loss of Piper Alpha platform	Lord Cullen's report / Safety Case Regulations (1992)
Pasadena USA	1989	Explosion and fire, 23 deaths, 100 injured	OSHA PSM 1910 (1992) and EPA RMP (1999)
Nova Scotia Canada	1992	Westray mine explosion, 26 dead	Bill C-45 (2004)
Longford, Australia	1998	Explosion and fire, 2 deaths, Melbourne without gas for 19 days	Major Hazard Facilities Regulations (2004)
Toulouse, France	2001	Explosion and fire 30 deaths, 2000 injured, 600 homes destroyed	Changes in Seveso Directive
Texas City, USA	2005	15 killed, 180 injured	Baker Report (2007) suggested creating 2 new ANSI standards, including 2005-4-I-TX-R6 (performance indicators for process safety)
Hertfordshire, UK	2005	Explosion and fire at Buncefield Depot	Pending

Trends in Process Safety Incidents

Contrary to the chart earlier which showed the UK's safety record, as defined by lost time injury frequency (LTIF), improving, a 2004 paper titled "Lessons Learned from Chemical Accidents and Incidents" concluded that there is no evidence of a significant reduction in the rate of major accidents reported under the Seveso Directives over the last 10 to 20, plus no change to average severity of reported accidents. Furthermore, they stated "there is clear indication that the total number of major incidents is relatively constant".¹⁹

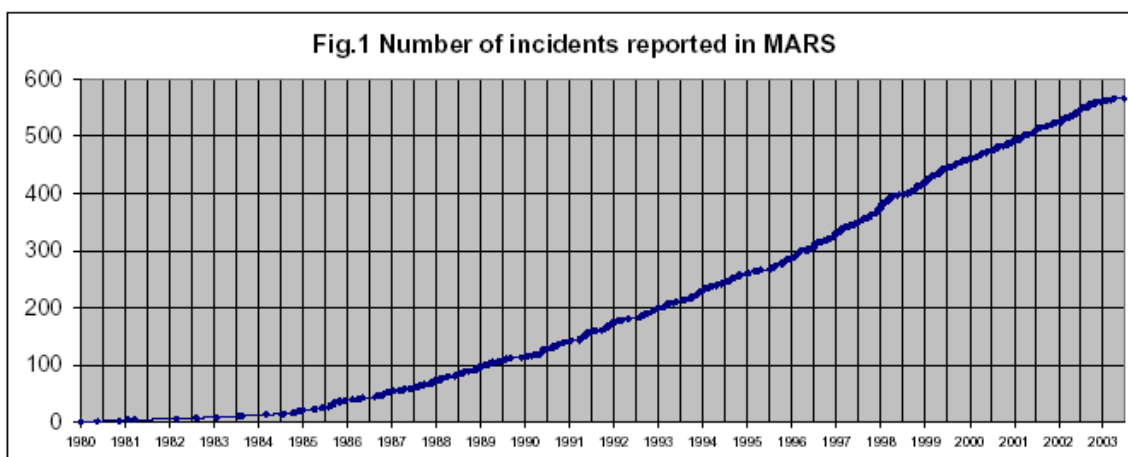


Figure 1

Sources: "Status of the Major Accident Reporting System"
(MARS, Michalis, 10th and 11th meetings of the Committee of the Seveso Competent Authorities)

As Figure 1 above illustrates, despite the adoption of PSM legislation in the industrialized world, accidents continue to occur regularly. For a more recent incident history in the US, check the US Chemical Safety and Hazard Investigation Board's website at <http://www.chemsafety.gov>.

Synopsis

After reviewing the history of major industrial incidents and the societal response to them, one key theme emerges:

Public outrage creates change. Australia's Longford Disaster Illustrates This Clearly.

Indeed, from a 2004 OECD workshop on lessons learned from chemical accidents and incidents, a Risk Report titled "Emerging Risks in The 21st Century" concludes with a section on "Learning the lessons." This section of the report notes:

"Disasters are followed by a period in which the attention of the public and the media are at their highest point and a window of opportunity for action opens. Experience of harm forces society to reevaluate risk and the way it is managed. However, whether such consideration is retained or acted upon is another matter. Investigating and analyzing the origins and consequences of disaster can provide lessons on how to improve assessment and management of risk. Such lessons can be extended to other similar risk areas (or regions). The momentum created in society can help overcome inertia and resistance to reforms in the risk management process. Effective management of the window of opportunity can reinforce citizen's confidence in the way risks are handled, and all in all significantly reduce the chances that the same disaster occurs again in the future."²⁰

Conclusions

1. The majority of standards and codes which govern risks within the world's process industries have been based on a prescriptive approach. Canada does not have the full legislative and regulatory requirements as in the United States (e.g. OSHA 29 CFR 1910.119) or European countries (e.g. Seveso II Directive). Our unique form of Process Safety Management standards is derived primarily from the Canadian Chemical Producers Association's Responsible Care® program developed in the 1980s. To a significant degree, the prescriptive approach of the US and Europe has led to an attitude in those countries whereby companies and their representatives focus on meeting the standard.
2. While the Canadian process industry has avoided prescriptive standards so far, there is no guarantee they will not be introduced. As long as companies continue to operate safely and without significant incident and perhaps most importantly, the public is not severely inconvenienced or harmed, governments will likely continue to follow the status quo. In other words, if there is no public outrage, it is extremely unlikely that

there will be the pressure on Canada's federal and provincial governments to draft a prescriptive Process Safety Management standard. However, should a process industry incident occur in Canada at all resembling Flixborough, Seveso, Bhopal, Pasadena, etc., the likelihood of direct government intervention will rise exponentially. Looking at our neighbors to the south, it was not until the United States experienced their own process industry disasters that laws and regulations began to change.

3. The Canadian process industry, its managers and workers need the support of organizations such as the Chemical Institute of Canada. The CIC and more specifically, the Process Safety Management Division is a continuation of work started in 1990 under MIACC. Its mission is to reduce the likelihood and consequences in Canada of process-related incidents and improve performance through the understanding and application of Process Safety Management. They have developed many ideas, tools, services and techniques which can aid companies in their desire to improve their operating practices, including:

- Site Self-Assessment Tool
- Quick guide to site hazard ranking
- PSM guide
- Directory of key tools and how to use them
- Directory of resources (where to get help)
- Risk Assessment Recommended Practices
- Business case
- MIACC Lists
- Mini-Guide

With the sheer volume of capital investment flooding into Canada's process industries (i.e. oil sands, mining, fertilizer, etc.) it is critical that companies continue to incorporate the principles and best practices extracted from past experience into their new plant design, construction and operation. The pending retirement of the baby boomer generation and their hard earned knowledge needs to be recognized and addressed within organizations. Training and mentoring bright, new entrants into the world of Process Safety Management must happen now.

Disasters do not respect international borders. We are all on one planet and connected to one ecosystem. We must work collaboratively for the health and safety of all people.

Footnotes

- 1 King, Ralph, King's Safety in the Process Industries, Wuerz Publishing, Page 16 (1998).
- 2 US OSHA 1910.119 Process Safety Management Rule, definitions.
- 3 CCPS Guidelines for Technical Management of Chemical Process Safety
- 4 Center for Chemical Process Safety web site
<http://www.aiche.org/CCPS/Students/GetSmart.aspx>
- 5 King, Ralph, King's Safety in the Process Industries, Wuerz Publishing, Page 2 (1998).
- 6 World Health Organization, Occupational Health web site
http://www.who.int/occupational_health/publications/globstrategy/en/index5.html
- 7 International Organization for Standardization web site
http://www.iso.org/iso/support/faqs/faqs_standards.htm
- 8 Center for Chemical Process Safety web site
<http://www.aiche.org/CCPS/Students/GetSmart.aspx>
- 9 Oil and Gas UK website
<http://www.oilandgasuk.co.uk/issues/health/piperalpha.cfm>
- 10 Jean-Paul Lacoursiere, Bhopal and its Effects on the Canadian Regulatory Framework, page 3 (2004).
- 11 Responsible Care web site – What We Do <http://www.responsiblecare.org>
- 12 Responsible Care web site - Responsible Care Fundamental Features
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- 13 Jean-Paul Lacoursiere, Bhopal and its Effects on the Canadian Regulatory Framework, page 2 (2004)
- 14 The Uncertain Promise of Law: Lessons from Bhopal p. 19 (1993)
- 15 Dole, Elizabeth, Phillips 66 Company Houston Chemical Complex Explosion and Fire, page vii, 1990
- 16 The Post-Bhopal and Post-9/11 Transformations in Chemical Emergency Prevention and Response Policy in the United States, page 2 (2005)
- 17 U.S. Chemical Safety and Hazard Investigation Board web site
- 18 The Post-Bhopal and Post-9/11 Transformations in Chemical Emergency Prevention and Response Policy in the United States, page 4 (2005)
- 19 OECD Workshop on Lessons Learned from Chemical Accidents and Incidents, page 13 (2004)²⁰ OECD Workshop on Lessons Learned from Chemical Accidents and Incidents, page 6 (2004)

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