

Part IV
Process Safety Management and System Safety Engineering

20

Process Safety Regulations Around the World

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We're all in this alone.

Lily Tomlin, American actress

20.1

Introduction

The goal of the loss prevention engineering and safety fields will always be the same: to avoid, prevent, or limit loss (injuries, property damage, etc.), immediate or delayed, on-site or off-site, to employees, to neighboring facilities, and to the public. However, the way in which industry accomplishes this, and also our definition of tolerable risk, have been revolutionized in the last few decades by advances in science and technology that have allowed companies and their loss prevention engineering and safety professionals to make the workplace safer.

During this period of time, institutions and corporations involved in an accident have focused accident investigations on finding the root cause and preventing reoccurrence. Based on these incident investigations, a wide range of professional organizations and government institutions around the world have developed guidelines and recommended practices (RPs), and implemented regulations with the intent of reducing the probability of having an undesired event at the workplace.

The purpose of this chapter is to collect the approaches that have been developed around the world with process safety in mind.

20.2

Process Safety – Drivers

Process safety management (PSM) is the application of management principles and systems to the identification, understanding, and control of process hazards. This application is intended to prevent or minimize the consequences of major uncontrolled (i.e., catastrophic) releases of toxic, reactive, flammable, or explosive chemicals. These events would normally occur due to failures in process, procedures, or equipment.

The main drivers for regulations regarding process safety around the world are the United States “PSM of Highly Hazardous Chemicals” regulation, the Seveso Directive that affects all Member States of the European Union, and the conventions and practices developed by the United Nations International Labour Organization (ILO) to prevent major accident hazards.

In 1992, the Occupational Safety and Health Administration (OSHA) in the United States promulgated its PSM regulation. This was considered a direct response to the 1984 Bhopal incident, the October 1989 chemical plant incident in Pasadena, Texas, and other major incidents involving highly hazardous chemicals (OSHA, 1992a).

The Seveso Directive, a European Union law aimed at improving the safety of sites containing large quantities of dangerous substances (European Parliament, 2003), was first issued in 1982 after several large-scale incidents that occurred in the 1970s, including those in the towns of Flixborough, UK and Seveso, Italy. The Seveso Directive was amended in 1987 and 1988 to broaden the scope of the Directive, particularly to include the storage of dangerous substances. The current version was adopted in December 1996 where new requirements relating to safety management systems, emergency planning and land-use planning, and a reinforcement of the provisions on inspections (i.e., enforcement) were included (European Commission, 1996).

In the United Kingdom, the Control of Major Accident Hazards (COMAH) regulations implement the Seveso Directive (HSE, 1999) (except for the land-use planning requirements, which are implemented by different pieces of legislation), replaced the Control of Industrial Major Accident Hazards Regulations (CIMAH), were originally issued in 1984 and came into force in April 1999. These regulations have been amended to reflect changes to Seveso.

In response to the need for cooperation, the Convention for the Prevention of Major Industrial Accidents took place in 1993 within the International Program on Chemical Safety, between the ILO, the United Nations Environment Program (UNEP), and the World Health Organization to discuss the code of practice on the same topic which had been issued in 1991 (ILO 1993).

These process safety initiatives have influenced the development of others around the world. The identified guidelines, practices, and regulations currently used by the industry are listed in Appendices 20.A–20.C. It is not the intent of the compiled lists to be comprehensive, but to present a global picture of the process safety field.

20.3 Differences and Commonalities

At first glance, process safety regulations look extremely similar. It is not until facility programs reach maturity that differences start to be more evident.

For the purpose of this section, OSHA’s PSM will be used as the baseline. This regulation contains requirements listed in 14 distinct paragraphs of the text of the law, traditionally called “elements.” The Process Safety basic elements are as follows:

- employee participation
- process safety information (PSI)
- process hazard analysis (PHA)
- operating procedures
- training
- contractors
- pre-startup safety review (PSSR)
- mechanical integrity (MI)
- hot work permit (HWP)
- management of change (MOC)
- incident investigation
- emergency planning and response (EPR)
- compliance audits
- trade secrets.

Given that its concern goes beyond employee safety and includes off-site consequences to members of the public or potential impacts to environmental receptors, the US Environmental Protection Agency (EPA) has a different perspective on a couple of items. The EPA's Risk Management Program (RMP) adds the following requirements to those listed before:

- management system,
- risk scenarios (quantitative) analyses,
- communication with local emergency services
- registration with the authorities (chemicals, potential impacts, RMP program).

The available guidance for the Seveso Directive developed by the Major Accident Hazards Bureau (MAHB) additionally includes the identification of potential security concerns (i.e., unauthorized interventions) as a potential hazard source (MAHB, 1997). This guidance also indicates that hazards should be avoided or reduced at the source through the application of inherently safe practices.

ILO's Prevention of Major Industrial Accidents code of practice contains the need to include provisions to ensure that organizational measures (including staffing levels, hours of work, and definition of responsibilities) have been considered in the management system for the program (ILO, 1991). ILO also recommends periodic testing and evaluation of their emergency planning procedures' effectiveness and revision as necessary, in addition to provisions to ensure the continuous improvement of the system, which includes the need for reviewing and updating the process safety program regularly. ILO goes one step further and indicates that the prevention program should promote the use of the best available safety technologies.

Both Seveso and ILO also include land-use planning requirements (ILO, 1991), in part to ensure that the siting of new establishments, modification of existing ones, and new developments in the vicinity have been evaluated with respect to the hazards in the facility. This is also presented as a conscious effort to make reasonable attempts to ensure that there is appropriate separation between major hazard installations and:

- facilities such as airports and reservoirs
- neighboring major hazard installations
- housing and other centers of population nearby.

While the manufacture of explosives in the United States, and other hazardous activities, remain as separate standards that may reference PSM, Seveso has been extended (European Commission, 2003) to cover risks arising from storage and processing activities in mining, from pyrotechnic and explosive substances and from the storage of ammonium nitrate and ammonium nitrate-based fertilizers.

20.4

Non-Regulatory Approaches

Perhaps one of the best known, non-regulatory approaches to process safety is Responsible Care. Responsible Care is a global initiative that began in Canada in 1984 and is practiced today by 55 national and regional associations in 60 economies around the world (ACC, 2012). The initiative contains several guiding principles that establish the foundation for a prevention program. Some of the guidelines provide a unique approach to PSM; the following stand out:

- Work with customers, carriers, suppliers, distributors, and contractors to foster the safe and secure use, transport, and disposal of chemicals, and provide hazard and risk information that can be accessed and applied in their operations and products.
- Design and operate facilities in a safe, secure, and environmentally sound manner.
- Instill a culture throughout all levels of the organization to identify, reduce, and manage process safety risks continually.
- Cooperate with governments at all levels and organizations in the development of effective and efficient safety, health, environmental, and security laws, regulations, and standards.
- Support education and research on the health, safety, environmental effects, and security of products and processes.

The Canadian Society for Chemical Engineering (CSCHE, 2002) as well as the Center for Chemical Process Safety (CCPS) (CCPS, 1994) in the United States have also issued guidelines related to process safety. They provide additional items to consider, such as:

- accountability: objectives and goals
- human factors (process equipment interface, administrative control versus hardware, human error assessment)
- enhancement of process safety knowledge.

The American Petroleum Institute (API) RP 750 was developed for refineries, petrochemical operations, and major processing facilities (API, 1990). Even though it was issued just before OSHA's PSM, the practice is still used in locations where

applicable regulatory requirements do not explicitly address process safety for this type of facilities.

The International Organization for Standardization (ISO), better known for their ISO 9000 and ISO 14000 programs regarding quality and environmental concerns, respectively, has issued a guideline for risk management. The ISO 31000 Risk Management standard establishes a number of principles to make risk management effective (ISO, 2009). Among others, some of these principles are:

- Continual and iterative communication and consultation processes to provide, share, or obtain information and to engage in dialogue with stakeholders regarding the management of risk.
- Commitment by management of the organization to achieve involvement at all levels. Management should:
 - define and endorse the risk management policy;
 - ensure that the organization’s culture and risk management policy are aligned;
 - determine risk management performance indicators that align with performance indicators of the organization;
 - align risk management objectives with the objectives and strategies of the organization;
 - ensure legal and regulatory compliance;
 - assign accountabilities and responsibilities at appropriate levels within the organization;
 - ensure that the necessary resources are allocated to risk management;
 - communicate the benefits of risk management to all stakeholders;
 - ensure that the framework for managing risk continues to remain appropriate.

Analogously, the American National Standards Institute (ANSI) Z10 provides critical management systems requirements and guidelines for improvement of occupational health and safety. Guidelines included are:

- management leadership and employee participation
- planning, implementation, and operation
- evaluation and corrective action
- management review.

The ANSI Z10 appendices address roles and responsibilities, policy statements, assessment and prioritization, incident investigation guidelines, and audit information, among others (ANSI, 2005). While ANSI Z10 was developed with occupational safety in mind (not process safety), the concepts can be applied to both programs.

Offshore facilities may sometimes be exempt from these regulations (OSHA, 1992b). However, API RP 75, Development of a Safety and Environmental Management Program (SEMP) for Offshore Operations and Facilities (API, 2008), addresses this type of facility. This practice provides guidance for use in preparing SEMPs for oil, gas, and sulfur operations and facilities located on the outer continental shelf (OCS). These guidelines are applicable to well drilling, servicing and production, and for pipeline facilities and operations that have the potential for creating a safety or environmental hazard at OCS platform sites. Eleven major

program elements are included for application to these facilities and operations. Identification and management of safety and environmental hazards are addressed in design, construction, startup, operation, inspection, and maintenance of new, existing, and modified facilities.

20.5

Lessons Learned

The safety field has advanced, unfortunately, thanks to major catastrophic events: the Triangle Shirtwaist Co. fire in 1911 (US Department of Labor, 2011), Feyzin in 1966 (HSE, 1966), Flixborough in 1974 (HSE, 1974), Seveso in 1976 (HSE, 1976), Bhopal (HSE, 1984b) and Mexico City in 1984 (HSE, 1984a), Pasadena in 1989 (HSE, 1989), Texas City in 2005 (CSB, 2005), the Macondo Blowout and Explosion in the Gulf of Mexico in 2010 (BOEMRE, 2011, to mention just a few, and also numerous mining- and construction project-related accidents. All of them have provided the industry with lessons that stand the test of time.

The Chemical Safety Board (CSB) is an independent US federal agency charged with investigating industrial chemical accidents. The purpose of the CSB is to convey information and recommendations to improve safety in the oil and chemical industries and protect workers and the environment. The CSB is not a regulatory body.

Recent investigations conducted by the CSB provide recommendations intended to direct process safety programs and regulatory efforts. Some of these are:

- MOC reviews to be conducted for organizational changes (CSB, 2005) that may impact process safety, including:
 - major organizational changes such as mergers, acquisitions, or reorganizations
 - personnel changes, including changes in staffing levels or staff experience
 - policy changes such as budget cutting
- conduct practice evacuation drills at least annually, but more frequently if necessary, to ensure that employees are prepared for emergencies (CSB, 2006).

In parallel, an independent review panel evaluated a group of refineries after the 2005 Texas City event (Baker, 2007); the report concluded that three main areas needed attention:

- corporate safety culture (including incorporating PSM into decision making)
- PSM systems, including implementation of good engineering practices (GEPs)
- Performance evaluation, corrective action, and corporate oversight.

During the aftermath of the Macondo Blowout and Explosion in the Gulf of Mexico (also known as Deepwater Horizon) in April 2010, it became evident that regulations are only as good as their enforcement. After the event, the Bureau of Safety and Environmental Enforcement (BSEE) was created to engage in responsibilities previously under the jurisdiction of the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE). The BSEE has undertaken regulatory reform initiatives, and has promulgated regulations, including one designed to address drilling safety, and workplace safety (Elournoy, 2011). It also

requires the development of a safety and environmental management system for offshore platforms which basically follows API RP 75.

20.6 Evolving Field

Safety legislation is attributed with having a significant impact on reducing work-related injuries (Greer, 2001). The approach the regulatory bodies have taken is through the development of performance-based standards that specify the desired outcome with few prescriptive requirements. This approach leaves the actual method of compliance up to the companies, where organizations define what constitutes compliance and whether they have complied.

Performance-based standards allow for one set of guidelines to cover a broad scope of processes. However, this type of regulations depend on the ability of government agencies to specify, measure, and monitor performance; situations which demand internal resources that may not be available. The future may rely on a combination of either performance standards with design standards (or codes of practice) or design standards with performance-based equivalency clauses (Coglianese, Coglianese, and Olmstead, 2003).

Recently developed enforcement guidelines in the United States are accomplishing just that. Inspections that follow the approach established by the National Emphasis Programs (NEP) for the refinery industry (OSHA, 2009) and chemical facilities (OSHA, 2011) focus on the organization's research and application of relevant GEPs. GEPs are developed by professional organizations such as the American National Standards Institute (ANSI), American Society of Mechanical Engineers (ASME), API, Institute of Electrical and Electronics Engineers (IEEE), and CCPS, to mention just a few; a list of specific GEPs listed in OSHA's NEP for Refineries is provided in Appendix 20.D.

These enforcement guidelines also focus more on the actual implementation of a program than on its documentation. For instance, in addition to the traditional PSM elements, the refinery NEP includes specific PSM auditable items within the following categories:

- relief systems
- blowdown drums and vents stacks (blowdowns)
- vessels
- piping
- PHA, incident investigation, and compliance audits findings/recommendations
- Facility Siting
- human factors
- piping and instrumentation diagram (P&ID) verification.

Regarding design standards, functional safety as presented by the ANSI/ISA S84/IEC 61511 standard for safety instrumented systems (SIS) for the process industry sector guides a design team to incorporate ways to take the process to a safe state when out-of-limit conditions have been reached. These systems are

often automated, but can also involve human action in response to alarms. Also, other quantitative (or semiquantitative) types of analyses such as layer of protection analysis (LOPA) are being used to ensure that safeguards are adequate, sufficient, and reliable enough to prevent or minimize the impact of loss of containment events. These approaches are gaining acceptance in the process industries.

Another industry development worth mentioning is the use of metrics for process safety. Several guidelines have been developed that review the concept and promote the use of performance indicators (OECD, 2005; HSE, 2006; API, 2010; CCPS, 2011).

20.7

General Duty

Perhaps the most important piece of regulation has already been implemented by countries around the world, the general duty clause.

Every operator shall take all measures necessary to prevent major accidents and limit their consequences to persons and the environment (HSE, 1999). Comparably, ILO established the need to ensure that all appropriate measures are taken to:

- prevent major accidents
- minimize the risks of major accidents
- minimize the effects of major accidents.

OSHA establishes a shared responsibility as it includes, in the same code, the following two paragraphs:

- 1) Each employer shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees (OSHA, 1970).
- 2) Each employee shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to this Act which are applicable to his own actions and conduct.

Canada takes the general duty clause one step further. Bill C-45 became law on 31 March 2004. It was created as a result of a 1992 coal mining disaster in Nova Scotia where 26 miners were killed after methane gas ignited, causing an explosion. Despite serious safety concerns raised by employees, union officials, and government inspectors at the time, the company instituted few changes. Eventually, the disaster occurred. After the accident, the government failed to secure a conviction against the company or its managers. The situation led to the creation of Bill C-45; its provisions:

- Created rules for establishing criminal liability to organizations for the acts of their representatives for negligence and other offenses.
- Established a legal duty for all persons “directing the work of others” to take reasonable steps to ensure the safety of workers and the public.
- Set out the factors that courts must consider when sentencing an organization.
- Provided optional conditions of probation that a court may impose on an organization.

Bill C-45 added a section to the criminal code which reads:

Every one who undertakes, or has the authority, to direct how another person does work or performs a task is under a legal duty to take reasonable steps to prevent bodily harm to that person, or any other person, arising from that work or task.

These provisions of the Criminal Code affect all organizations and individuals who direct the work of others, anywhere in Canada. These organizations include federal, provincial, and municipal governments, corporations, private companies, charities, and non-governmental organizations.

20.8

Proposed Changes to Regulations

The Seveso Directive and OSHA's PSM are scheduled to be revised to conform to the UN's Globally Harmonized System of Classification and Labeling of Chemicals (GHS) hazards (classification, labeling, and packaging of dangerous substances and mixtures). In part, OSHA's PSM regulation is scheduled for this revision because the GHS triggered a change on the Hazard Communication Standard (HCS) which provides a definition for flammable materials, a definition which is referenced in the PSM regulation. The scope of the PSM regulation is not expected to change; it will now include its own definition for flammable materials to be subject to PSM.

The industry expects that the agencies will also take the opportunity to introduce several other modifications.

For instance, the CSB has asked OSHA and EPA to broaden PSM to cover both individual chemicals and combinations of chemicals that can undergo hazardous reactions under specific process conditions, basically expanding the current understanding of reactivity incidents.

Other potential revisions may be related to listed chemicals and threshold amounts, including the addition of new named substances, and also additional guidance to ensure applicability is determined by the chemical components and effects more than by the names of the chemicals.

20.9

Summary

The compilation of the concepts presented here provides an outline, a roadmap for process safety, that goes beyond any one of the main drivers individually. Such an outline is provided in greater detail in Appendix 20.E. A possible outline for process safety programs contains 16 sections or elements. The requirements would look as follows:

- 1) applicability
- 2) management system
- 3) leadership and involvement
- 4) process safety information (PSI)

- 5) hazard analyses (task, process, facility)
- 6) procedures (operating, emergency response, and maintenance procedures)
- 7) training
- 8) contractors (including subcontractors)
- 9) mechanical integrity (MI)
- 10) Safe Work Practices (SWPs)
- 11) management of change (MOC)
- 12) pre-startup safety review (PSSR)
- 13) incident investigation and analysis
- 14) emergency planning and response (to protect employees, the public, and the environment)
- 15) continuous improvement (audits, findings follow-up, documentation)
- 16) trade secrets.

20.10

Future of Process Safety

The complexity of the chemical industry makes a generic, one-size-fits-all regulation inappropriate as it needs to accommodate different types of processes and products in addition to diverse geographic, cultural, and social conditions (Beebe, 2006).

Regulations will always be imperfect as they cannot cover every exigency (Perrow, 2011). In other words, a regulatory requirement is the established and agreed upon minimum. The industry will continue to expect the establishment of these minimum requirements to benchmark itself.

The guidelines and regulations available are based on the industry's cumulative knowledge based on past experiences. As Admiral Hyman G. Rickover, considered the Father of the Nuclear Navy, once said: "It is necessary for us to learn from the mistakes of others. You will not live long enough to make them all yourself." This is the reason why guidelines and regulations are important, and yet it is also the reason why they are not sufficient.

It is also important to mention that there is no unique approach to ensure process safety; each one of these approaches present challenges and limitations when applied to a company or field in particular. Each organization can, and should, apply the prevention program initiatives that are a better fit for their process, their people, and their locale.

In a way, whether one is required to follow a specific guideline or regulation, or is looking for best practices, each organization needs to develop its own version of a process safety program. The program should be based on applicable guidelines and regulations, but with a design based on the site's culture and own learned lessons, taking advantage of programs and practices previously developed, available tools, and also designed to achieve continuous improvement.

The future of process safety relies, then, on each process safety professional around the world to share the approaches that are successful, providing new information for others to absorb and implement, closing the loop, and contributing to the field's never-ending cycle of continuous improvement.

Appendix 20.A: Process Safety Drivers

Country/ region	Agency/ institution/ organization	Description	Identifier	Link	Notes
USA	EPA	Risk Management Program (RMP) Rule	40 CFR 68	http://www.epa.gov/oem/content/rmp/	EPA's RMP web site
USA	OSHA	Process Safety Management (PSM)	1910.119	http://www.osha.gov/SLTC/processsafety-management/index.html	OSHA's PSM web site
Europe	European Commission Joint Research Centre (JRC)	Major Accident Hazards Bureau (MAHB)	SEVESO Directive	http://ec.europa.eu/environment/seveso/index.htm	Directive's web site: description and documentation
Europe	European Commission Joint Research Centre (JRC)	Major Accident Hazards Bureau (MAHB)	SEVESO Directive	http://ipsc.jrc.ec.europa.eu/index.php/Information-material/503/0/	Guidance documents and other information
Europe	European Commission Joint Research Centre (JRC)	Major Accident Hazards Bureau (MAHB)	SEVESO Directive	http://ec.europa.eu/environment/seveso/natautho.htm	Member States: Chemical Accidents (Seveso II) – National authorities and other structures
UK	Health and Safety Executive	Dangerous Substances and Explosive Atmospheres Regulations	SI 2002 No. 2776	http://www.legislation.gov.uk/ukxi/2002/2776/contents/made	Other regulations address notification of sites with hazardous substances, land use planning, offshore activities
UK	Health and Safety Executive (HSE)	Control of Major Accident Hazards (COMAH) Regulations	1999 No. 743	http://www.hse.gov.uk/comah/index.htm	COMAH web site
Worldwide	ILO	Prevention of major industrial accidents	Code of Practice	http://www.ilo.org/safework/info/standards-and-instruments/codes/WCMS_107829/lang-en/index.htm	Prevention of major industrial accidents, Code of Practice, web site

Appendix 20.B Process Safety Regulations Around the World

Area	Country/ region	Jurisdiction	Agency/institution/ organization	Description	Identifier	Link	Notes
Americas	Argentina	Federal	Ministerio de Trabajo, Empleo y Seguridad Social (Labor Department)	Registro Nacional para la Prevención de Accidentes Industriales Mayores	Superintendencia de Riesgos del Trabajo Resolución 743/2003	http://infoleg.mecon.gob.ar/infolegInternet/anexos/90000-94999/90519/norma.htm	—
Americas	Bolivia	Federal	Ministerio de Desarrollo Sostenible y Medio Ambiente (Environment and Sustainable Development Department)	Ley de Hidrocarburos No. 1689	1996	http://www.anh.gob.bo/Documentos/Dj/Normativa/DS-NRO-24721.pdf	Hydrocarbons law contains several guidelines and requirements for the construction and operation of hydrocarbons facilities
Americas	Bolivia	Federal	Ministerio de Desarrollo Sostenible y Medio Ambiente (Environment and Sustainable Development Department)	Reglamento de Normas Técnicas y de Seguridad para las Actividades de Exploración y Explotación de Hidrocarburos	Decreto Supremo No. 24689	http://www.cbh.org.bo/archivos/docs/24689.pdf	Safety rules for the exploration and exploitation of hydrocarbons
Americas	Canada	Federal	Canadian Centre for Occupational Health and Safety (CCOHS)	Criminal Code	Bill C-45	http://www.ccohs.ca/oshanswers/legisl/billic45.html	Legal duties for workplace health and safety, and serious penalties for violations that result in injuries or death; general duty clause for those that “direct the work of others”

Americas Canada	Ontario	Occupational Health and Safety Act	R.R.O. 1990, Regulation O. Reg. 98/11 851 Industrial Establishments		http://www.e-laws.gov.on.ca/html/reg/english/elaws_regs_900851_e.htm#BK6	PSSR requirement for certain situations
Americas Canada	Provincial	Alberta Occupational Health and Safety Act	Code and Regulation (2009)	2009	http://employment.alberta.ca/documents/WHS/WHS-LEG_ohsc_2009.pdf	Includes hazard assessment and some other elements of a PSM program
Americas Mexico	Federal	SE (Energy Agency)	Instalaciones de Aprovechamiento de Gas Natural	NOM-002-SECRE-2010	http://www.sener.gob.mx/webSener/res/Acerca_de/NOM-002-SECRE20-10.pdf	Natural gas facilities; guidelines for installation and maintenance
Americas Mexico	Federal	SEMARNAT (Environmental Agency)	Guía para la Presentación del Estudio de Riesgo	—	http://www.semarnat.gob.mx/servicios/antecedentes/tramita-oid/informaciondetramites/Impacto%20ambiental/GUIAS/RIESGO/GUIA%20DE%20ERA%20MODALIDAD%20ANALISIS%20FINAL.pdf	Risk analysis approach for new installations
Americas Mexico	Federal	STPS (Labor Department)	Condiciones de Seguridad e Higiene en los Centros de Trabajo donde se Manejen, Transporten, Procesen o Almacenen Sustancias Químicas Capaces de Generar Contaminación en el Medio Ambiente Laboral	NOM-010-STPS-2000	http://asinom.stps.gob.mx:8145/upload/nom/10.pdf	Rule related to handling and storing chemical substances; and guidelines to assess and minimize potential for exposure

Appendix 20.B (continued)

Area	Country/ region	Jurisdiction	Agency/institution/ organization	Description	Identifier	Link	Notes
Americas Mexico	Federal	Federal	STPS (Labor Department)	Mantenimiento de las Instalaciones Eléctricas en los Centros de Trabajo – Condiciones de Seguridad	NOM-029-STPS-2011	http://asinom.stps.gob.mx:8145/upload/noms/Nom-029.pdf	Guidance for maintenance of electrical installations
Americas Mexico	Federal	Federal	STPS (Labor Department)	Organización del Trabajo – Seguridad en los Procesos de Sustancias Químicas	NOM-028-STPS-2004	http://asinom.stps.gob.mx:8145/upload/noms/Nom-028.pdf	Equivalent to OSHA's PSM
Americas USA	Federal	Federal	OSHA	Combustible Dust in Industry: Preventing and Mitigating the Effects of Fire and Explosions	Safety and Health Information Bulletin	http://www.osha.gov/dts/shib/shib073105.html	OSHA's Combustible Dust guidance
Americas USA	Federal	Federal	OSHA	Explosives and Blasting Agents Rule	1910.109	http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=9755&p_table=STANDARDS	Explosives rule that references PSM for explosives and pyrotechnics manufacturers
Americas USA	Offshore	Offshore	BOEMRE	Safety and Environmental Management Systems (SEMS) for Outer Continental Shelf Oil and Gas Operations	30 CFR Part 250	http://www.boemre.gov/sempr/	BOEMRE's SEMS web site
Americas USA	State of California	State of California	California Code of Regulations, Public Safety, Office of Emergency Services	CalARP program	Chapter 4.5	http://www.calarp.com/CalARP%20Regs.pdf	Equivalent to federal RMP program, with minor differences

Americas	USA	State of California	General Industry Safety Orders, Control of Hazardous Substances	Process Safety Management of Acutely Hazardous Materials	§5189	http://www.dir.ca.gov/title8/5189.html	Equivalent to federal PSM program, with minor differences
Americas	USA	State of California	Contra Costa County	Industrial Safety Ordinance	Chapter 450-8	http://cchealth.org/groups/hazmat/pdf/iso/2006_iso_official_code_complete.pdf	Risk management guidelines
Americas	USA	State of Delaware	State of Delaware	Extremely Hazardous Substances Risk Management Act	Chapter 77	http://delcode.delaware.gov/title7/c077/index.shtml	Equivalent to federal RMP program, with minor differences
Americas	USA	State of Nevada	Division of Environmental Protection/Bureau of Air Pollution Control	Chemical Accident Prevention Program (CAPP); Regulation of Highly Hazardous Substances and Explosives	NRS 459.380	http://ndep.nv.gov/bapcc/capp/capp.html	Guidance for PSM and RMP programs
Americas	USA	State of New Jersey	NJ Department of Environmental Protection/Radiation Protection and Release Prevention	Toxic Catastrophe Prevention Act (TCPA) Program	N.J.A.C. 7:31	http://www.nj.gov/dep/rpp/brp/tpa/index.htm	Similar to federal RMP program, with minor differences
Arab States and Africa	Abu Dhabi Emirate	Abu Dhabi	Abu Dhabi Environment, Health, and Safety Center	Abu Dhabi Environment, Health, and Safety Management System Regulatory Framework (AD EHSMS RF)	Version 2.0 – February 2012	http://www.adehsms.ae/Pages/ADEHSMSDetails.aspx	Risk management system guidance; includes a general duty statement
Arab States and Africa	Abu Dhabi Emirate	ADNOC Oil Concession Areas	ADNOC – National Oil Company	ADNOC Codes of Practice	—	http://www.adnoc.ae/content.aspx?newid=136&mid=136	High-level standard setting documents for the safe operation of facilities

Appendix 20.B (continued)

Area	Country/ region	Jurisdiction	Agency/institution/ organization	Description	Identifier	Link	Notes
Arab States and Africa	Saudi Arabia	Saudi Arabia	Ministry of Interior	Safety Management System	—	http://www.moi.gov.sa/wps/portal/!ut/p/b1/04_Sj9CpYkssy0xPLMnMz0vMAfGjzOLd_cKcj09jA0N3DxdDTwDpb28jN3Djj1DjPWD_U_POC7ldFQH7ze9j/	Information only available to companies in the Kingdom of Saudi Arabia as hard copy
Arab States and Africa	Algeria	Federal	Ministère des Travaux Publics	Law 04-20 Relative to 25 Major Risks	December 2004	http://www.mtp.gov.dz/GUIDE%20URIDIQUE/textes-de-portee-generale/5-Loi-n-2004-20.pdf	Similar to OSHA; Seveso, COMAH; oil and gas installations follow Algerian hydrocarbon law which requires adherence to the best practices available
Asia and the Pacific	Australia	Offshore	NOPSEMA	Occupational Health and Safety in Offshore Petroleum Operations	Established on 1 January 2012	http://www.nopsema.gov.au/legislation-and-regulations/safety-health/	Several regulations related to health and safety; well integrity; environment
Asia and the Pacific	Australia	Victoria	Occupational Health and Safety Regulations 2007	Major Hazard Facilities	S.R. No. 54/2007; Part 5.2	http://www.worksafe.vic.gov.au/wps/wcm/connect/wsiinternet/WorkSafe/Home/Laws+and+Regulations/Acts+and+Regulations/Regulation_Overviews/	—
Asia and the Pacific	India	Federal	Ministry of Commerce and Industry – Petroleum, and Explosive Safety Organization	Explosives Acts and Rules, Gas Cylinders Rules, Petroleum Act and Rules	2004	http://peso.gov.in/index.aspx	Several guidelines and regulations available in this portal
Asia and the Pacific	India	Federal	Directorate General, Factory Advice Service, and Labor Institutes	Major Accident Control Rules	1997:2001	http://www.dgfasi.nic.in/RTI/mahc_rules.htm	—

Asia and the Pacific	India	Federal	Ministry of Environment and Forests	Manufacture, storage, and import of hazardous chemicals rules	1989	http://dpcc.delhigovt.nic.in/act_hzchem.htm	—
Asia and the Pacific	India	Federal	Ministry of Environment and Forests	The Chemical Accidents (Emergency Planning, Preparedness, and Response) Rules	1996	http://envfor.nic.in/legis/hsm/gsr347.htm	—
Asia and the Pacific	India	Federal	Ministry of Environment	Manufacture, Storage, and Import of Hazardous Chemicals (Federal)	2000	http://www.moef.nic.in/legis/hsm.htm	List of Hazardous Substances Management Legislations
Asia and the Pacific	India	Federal	Ministry of Labour and Employment	Factories Act (Federal) and factories Rules for each State of India	1948, as amended in 1987	http://www.dgfasi.nic.in/statutes5.htm	Includes provisions relating to hazardous processes
Asia and the Pacific	Japan	Federal	厚生労働省 (Ministry of Health, Labor, and Welfare)	労働安全衛生法 (Industrial Safety and Health Act)	Act No. 57 of 8 June 1972; 2006	http://www.japanese-lawtranslation.go.jp/Law/detail/?id=1926&vm=&re=&new=1	Original text: http://law.e-gov.go.jp/htmldata/S47/S47HO057.html
Asia and the Pacific	Japan	Federal	経済産業省 (Ministry of Economy, Trade, and Industry)	電気事業法 (Electricity Business Act)	Act No. 170 of 11 July 1964; 2005	http://www.japanese-lawtranslation.go.jp/Law/detail/?vm=04&re=01&id=51	Original text: http://law.e-gov.go.jp/htmldata/S39/S39HO170.html
Asia and the Pacific	Japan	Federal	経済産業省 (Ministry of Economy, Trade, and Industry)	高圧ガス保安法 (High Pressure Gas Safety Act)	Act No. 204 of 7 June 1951; 2005	http://www.japanese-lawtranslation.go.jp/Law/detail/?vm=04&re=01&id=1974	Original text: http://law.e-gov.go.jp/htmldata/S26/S26HO204.html

Appendix 20.B (continued)

Area	Country/ region	Jurisdiction	Agency/institution/ organization	Description	Identifier	Link	Notes
Asia and the Pacific	Japan	Federal	経済産業省, 総務省 (Ministry of Internal Affairs and Communications)	石油コンビナート等災 害防止法 (Act on the Prevention of Disaster in Petroleum Industrial Complexes and Other Petroleum Facilities) 消防法 (Fire Service Act)	1991	http://law.e-gov.go.jp/htmldata/S50/S50HO084.html	—
Asia and the Pacific	Japan	Federal	総務省 (Ministry of Internal Affairs and Communications)	(Fire Service Act)	Act No. 186 of 24 July 1948; 2008	http://www.japanese-lawtranslation.go.jp/law/detail/?id=1994&vm=04&r=02	Original text: http://law.e-gov.go.jp/htmldata/S23/S23HO186.html
Asia and the Pacific	Malaysia	Federal	Department of Occupational Safety and Health	Control of Industrial Major Accident Hazards, and Occupational Safety, and Health Regulations	Directive 20; 1996	http://www.dosh.gov.my/doshv2/phocadownload/Regulations/AKKP/peperaturan2.pdf	—
Asia and the Pacific	Singapore	Singapore	Ministry of Manpower	Guidelines on Prevention and Control of Chemical Hazards	—	http://www.mom.gov.sg/Documents/safety-health/factsheets-circulars/Prevention%20and%20Control%20of%20Chemical%20Hazards.pdf	—
Asia and the Pacific	Singapore	Singapore	Ministry of Manpower	Guidelines on Toxic Industrial Waste Treatment	—	http://www.mom.gov.sg/Documents/safety-health/factsheets-circulars/OSH%20Guidelines%20on%20Toxic%20Industrial%20Waste%20Treatment.pdf	Includes provisions relating to hazard analysis

Asia and the Pacific	Singapore	Singapore	Ministry of Manpower	Workplace Safety and Health Regulations	2006	http://www.mom.gov.sg/workplace-safety-health/safety-health-management-systems/Pages/wsh(risk-management)-regulations2006.aspx	Risk Management Regulations
Europe and Central Asia	Germany	Federal	Federal Ministry of Labor and Social Affairs (BMAS)	German Federal Institute for Occupational Safety and Health (BAuA)	2010; 2011	http://www.baua.de/en/Topics-from-A-to-Z/Hazardous-Substances/TRGS/pdf/Hazardous-Substances-Ordinance.pdf?__blob=publicationFile&?y=8	Risk assessment requirements
Europe and Central Asia	France	Federal	Ministre de l'Aménagement du Territoire et de l'Environnement	Prévention des Accidents Majeurs Impliquant des Substances	10 mai 2000; 25 décembre 2011	http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000000752492&dateTexte=	Prevention of major accidents involving dangerous substances, Environmental Department
Europe and Central Asia	France	Federal	Ministre de l'Aménagement du Territoire et de l'Environnement	Prévention des Accidents Majeurs Impliquant des Substances	29/09/2005	http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT00000245168&dateTexte=	Prevention of major accidents involving dangerous substances, Environmental Department
Europe and Central Asia	Italy	Federal	Parlamento Italiano	Artuazione dell'Articolo 1 della Legge 3 Agosto 2007, n. 123, in Materia di Tutela della Salute e della Sicurezza nei Luoghi di Lavoro	08/08	http://www.parlamento.it/parlam/leggi/deleghe/080801dl.htm	Main policy for health and safety in the workplace; references other EC standards
Europe and Central Asia	The Netherlands	Federal	Dutch Standards Institute	Besluit Risico Zware Ongevallen (BRZO)-Regulation	2012	http://www.publicatierieksgevaarlijkestoffen.nl/	Publication series on dangerous substances

Appendix 20.B (continued)

Area	Country/ region	Jurisdiction	Agency/institution/ organization	Description	Identifier	Link	Notes
Europe and Central Asia	The Nether- lands	Federal	Ministry of Infrastructure and the Environment	—	—	http://www.infomil.nl/onderwerpen/hindergezondheid/veiligheid/	Safety regulations web site
Europe and Central Asia	The Nether- lands	Federal	Ministry of Infrastructure and the Environment	—	—	http://www.rijksoverheid.nl/onderwerpen/gevaarlijke-stoffen	Hazardous substances web site
Europe and Central Asia	The Nether- lands	Federal	Rijksinstituut voor Volksgezondheid en Milieu (National Institute for Health and Environment)	Besluit Externe Veiligheid Inrichtingen (BEVI) – Regulation	—	http://www.rivm.nl/Onderwerpen/Onderwerpen/E/Externe_Veiligheid	External Safety Centre guidelines web site; intended to manage the risks to people living near facilities with hazardous materials
Europe and Central Asia	The Nether- lands	Federal	Risk Management Association	Publicatiereeks Gevaarlijke stoffen (PGS)	2011	http://www.latr.b.nl/	Guidelines to fulfill BRZO and BEVI requirements
Europe and Central Asia	Spain	Federal	Ministerio de Industria, Energía y Turismo	Prevencción de Accidentes Mayores	—	http://www.f2i2.net/LegislacionSeguridadIndustrial/legislacionNacionalGrupo.aspx?idregl=43	Major accidents prevention, industrial safety legislations portal

CalARP = California Accidental Release Prevention; NOPSEMA = National Offshore Petroleum Safety and Environmental Management Authority; STPS=Secretaría del Trabajo y Previsión Social (Labor Department, Mexico).

Appendix 20.C Non-Regulatory Approaches

Agency/institution/ organization	Description	Identifier	Link	Notes
Australia; New Zealand – ISO	Risk Management – Principles and Guidelines	AS/NZS ISO 31000:2009	http://sheraq.org/31000.pdf	Australia and New Zealand version of the ISO-31000 standard
Canadian Society for Chemical Engineering (CSChE)	Process Safety Management	2002	http://www.cheminst.ca/index.php?ci_id=3199&la_id=1	—
India – National Disaster Management Authority	National Disaster Management Guidelines – Chemical Disasters	April 2007	http://ndma.gov.in/ndma/guidelines/Chemical-Disaster.pdf	—
Mexico PEMEX (State-owned company)	Estudios de Riesgo	NRF-018-PEMEX-2007	http://www.pemex.com/files/content/NRF-018-PEMEX-2007F.pdf	Internal Process Hazard Analysis Guideline
Saudi Arabia – Saudi Aramco	Saudi Aramco Suppliers Safety Management System Manual	2011	http://www.saudiaramco.com/content/dam/Publications/Forms/Doing%20Business%20with%20U-%20forms/Saudi%20Aramco%20Suppliers%20Safety%20Management%20(SSMS).pdf	Safety management system guidelines for suppliers, contractors, and site operators for Saudi Aramco
UK – International Association of Oil and Gas Producers	Asset Integrity – The Key To Managing Major Incident Risks	OGP Report #415, 12/2008	http://www.ogp.org.uk/pubs/415.pdf	Risk management system guidance
UK – Risk Management Standard	The Institute of Risk Management (IRM), The Association of Insurance and Risk Managers (AIRMIC) and ALARM The National Forum for Risk Management in the Public Sector	2002	http://www.theirm.org/publications/documents/Risk_Management_Standard_030820.pdf	—

Appendix 20.C (continued)

Agency/institution/ organization	Description	Identifier	Link	Notes
USA Chemical Safety Board (CSB)	Incident Investigations; Reports, Recommendations, and Descriptive Videos	—	http://www.csb.gov/	The CSB (independent federal non-regulatory agency) makes recommendations to plants, regulatory agencies, industry organizations, and labor groups
ANSI/API	Process Safety Performance Indicators for the Refining and Petrochemical Industries	RP 754	http://www.api.org/environment-health-and-safety/process-safety/process-safety-standards/measuring-process-safety-rp-754.aspx	—
ANSI/API	Fatigue Risk Management Systems for Personnel in the Refining and Petrochemical Industries, First Edition	RP 755	http://www.api.org/~media/Files/EHS/Process-Safety/RP-755-Fact-Sheet.aspx	Fatigue prevention guidelines
ANSI/AIHA	American National Standard for Occupational Health and Safety Management Systems	Z10-2005	—	Voluntary consensus standard providing critical management systems requirements and guidelines for improvement of occupational health and safety
ANSI/ISA	Functional Safety: Safety Instrumented Systems for the Process Industry Sector	S84.00.01-2004/IEC 61511	http://www.isa.org/Template.cfm?Section=press_releases&template=/ContentManagement/ContentDisplay.cfm&ContentID=54887	GEP for SIS (safety instrumented systems)
API	Development of a Safety and Environmental Management Program for Offshore Operations and Facilities	RP 75	http://www.api.org/oil-and-natural-gas-overview/exploration-and-production/offshore/exploration-management.aspx	—

API	Guidance Document for the Development of a Safety and Environmental Management System for Onshore Oil and Natural Gas Production Operation and Associated Activities	RP 75L	http://www.api.org/	—
API	Management of Hazards Associated with Location of Process Plant Buildings	RP 752	http://www.api.org/environment-health-and-safety/process-safety/process-safety-standards/standard-rp-752.aspx	—
API	Management of Hazards Associated with Location of Process Plant Portable Buildings	RP 753	http://www.api.org/environment-health-and-safety/process-safety-standards/standard-rp-753.aspx	—
API	Management of Process Hazards	RP 750	http://www.api.org/	—
CCPS	Guidelines for Implementing Process Safety Management Systems	15 April 1994	http://www.aiche.org/ccps/	—
CCPS	Guidelines for Process Safety Management Programs	(Several)	http://www.aiche.org/ccps/	Guidelines available through this portal
CCPS	Leading and Lagging Indicators	2011	http://www.aiche.org/uploadedFiles/CCPS/Metrics/CCPS_ProcessSafety_Metrics_2011_FINAL.pdf	—
CSB	Process Safety Incident Investigations and Safety Cases	(Several)	http://www.csb.gov/	—
ICCA	Responsible Care	—	http://www.icca-chem.org/en/Home/Responsible-care/	—
ILO	OSH Management System: a Tool for Continual Improvement	28 April 2011	http://www.ilo.org/safework/info/publications/WCMS_153930/lang-en/index.htm	—
ISO	Risk Management – Principles and Guidelines	31000:2009	http://hsec.ir/file/pdf/ISO-31000.pdf	—

Appendix 20.C (continued)

Agency/institution/ organization	Description	Identifier	Link	Notes
NFPA	National Fire Alarm and Signaling Code	NFPA 72	http://www.nfpa.org/aboutthecodes/AboutTheCodes.asp?DocNum=72	—
OECD	Guidance on Safety Performance Indicators	Rev. 2005	http://www.oecd.org/dataoecd/60/39/21568440.pdf	—
OECD	Guiding Principles for Chemical Accident Prevention, Preparedness, and Response	2nd edition, 2003	http://www.oecd.org/dataoecd/10/37/2789820.pdf	—
UNECE	Convention on the Transboundary Effects of Industrial Accidents	—	http://www.unece.org/env/teia/welcome.html	Convention on the transboundary effects of industrial accidents is designed to protect people and the environment
UNEP	UN – Hazard Identification and Evaluation in a Local Community	—	http://www.unep.fr/shared/publications/pdf/WEBx0062xPA-HazardId.pdf	—

AIHA = American Industrial Hygiene Association; ICCA = International Council of Chemical Associations; OECD = Organization for Economic Co-operation and Development; PEMEX = Petróleos Mexicanos (State-owned oil company, Mexico); UNECE = United Nations Economic Commission for Europe; ISA = International Society of Automation; IEC = International Electrotechnical Commission.

Appendix 20.D: Good Engineering Practices (GEPs) Listed in the OSHA NEP for Refineries (CPL 03-00-004)

- **Plant Piping**
 - API 570 – Piping Inspection Code, American Petroleum Institute, 2nd edn, 10/98
 - * Addendum 1 – 2/2000, Addendum 2 – 12/01, Addendum 3 – 8/2003; API
 - API RP 574 – Inspection Practices for Piping System Components, 2nd edn, 1998, API
 - API RP 578, Material Verification Program for New and Existing Alloy Piping Systems, 1st edn, 1998, API
 - ASME B31.3 – Process Piping; ASME
- **Pressure Vessels and Atmospheric Storage Tanks**
 - API 510 – Pressure Vessel Inspection Code: Maintenance Inspection, Rating, Repair, and Alteration; 8th edn
 - * Addendum 1 – 12/98, Addendum 2 – 12/2000, Addendum 3 – 12/2001; and Addendum 4 – 8/2003; API
 - API Recommended Practice (RP) 572 – Inspection of Pressure Vessels, 2nd edn, 2001, API
 - API/(ANSI) Standard (STD) 521 – Pressure Relieving and Depressuring Systems, 5th edn, 2007, API
 - API RP 576 – Inspection of Pressure Relieving Devices, 2nd edn, 2000, API
 - ASME Boiler and Pressure Vessel Code, ASME
- **Maintenance**
 - API RP 579, Fitness-for-Service, 2000, API
- **Facility Siting**
 - API RP 752, Management of Hazards Associated with Location of Process Plant Buildings, 2nd edn, 2003, API
- **Management**
 - API Publication 770, A Manager’s Guide to Reducing Human Errors, Improving Human Performance in the Process Industries, 2001, API
- **CCPS Guidelines**
 - Guidelines for Writing Effective Operating and Maintenance Procedures, CCPS
 - Guidelines for Mechanical Integrity Systems, CCPS
 - Guidelines for Engineering Design for Process Safety, CCPS
 - Guidelines for Process Safety Documentation, CCPS
 - Guidelines for Auditing Process Safety Management Systems, CCPS
 - Guidelines for Facility Siting and Layout, CCPS
 - Guidelines for Evaluating Process Plant Buildings for External Fires and Explosions, CCPS
 - Safe Design and Operation of Process Vents and Emission Control, CCPS
 - Plant Guidelines for Technical Management of Chemical Process Safety, CCPS
 - Guidelines for Investigating Chemical Process Incidents, 2nd edn, CCPS

- **Fire Protection**

- NFPA 25 – Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, NFPA
- Dow’s Fire and Explosion Index Hazard Classification Guide, 7th edn, AIChE
- Chemical Engineer’s Condensed Encyclopedia of Process Equipment, 2nd edn, 2004, N.P. Chermisionoff

Appendix 20.E: The Author’s Suggestion for a Possible Outline for a Process Safety Management Program, Based on Concepts Derived from the Main Process Safety Drivers

1) **Applicability**

- a. Determination, and confirmation of, the boundaries of the process:
 - i. raw materials, intermediates, products, by-products:
 - I) flammable, explosives
 - II) toxics, reactive
 - ii. analysis of compatibility of materials:
- b. Communication and registration with authorities:
 - i. documented response from authorities (e.g., acknowledgment for the receiving of information; prohibition of use rationale)
 - ii. periodically updated (e.g., at least every 5 years)
- c. Possible exemptions (industries or services normally addressed by other regulations) may include:
 - i. nuclear installations,
 - ii. military installations,
 - iii. transport (e.g., pipeline, tanker truck, rail car).

2) **Management System**

- a. Define, develop, and endorse a Process Safety Policy that includes:
 - i. a general duty statement and
 - ii. accountability for those who “direct the work of others”
- b. Ensure adequate allocation of resources to risk management:
 - i. human, including but not limited to:
 - I) staffing levels
 - II) hours of work
 - III) definition of responsibilities
 - ii. financial
 - iii. technical
- c. Establish objectives and goals, and periodically evaluate performance with the use of metrics:
 - i. ensure that the organization’s culture and risk management policy are aligned
 - ii. align risk management objectives with the objectives and strategies of the organization

- d. Ensure strategic and rigorous planning to achieve commitment at all organizational levels. Management should:
 - i. ensure legal and regulatory compliance
 - ii. incorporate process safety into decision making
 - iii. engage in dialogue with, and communicate the benefits of risk management to all stakeholders.
- 3) **Leadership and Involvement**
 - a. Written plan of action regarding the mechanisms to ensure involvement of employees (including managers), customers, carriers, suppliers, distributors, and contractors
 - b. Lessons learned (including incident reports) proactive communication
 - i. affected personnel (including contract employees where applicable)
 - ii. authorities
 - iii. facilities with similar operations
 - iv. other interested parties
 - c. Communication and consultation with workers and representatives on the conduct and development of process hazards analyses and on the development of the other elements of process safety management.
- 4) **Process Safety Information** (compilation of written information about the process to identify and understand its hazards), including information pertaining to:
 - a. Design, technology and equipment, safety systems, construction, choice and hazards of chemicals used or produced by the process, operation, maintenance, and systematic inspection of the installation
 - b. Functional safety determination
 - c. Human factors design (tasks, people, procedures, workplace, equipment, computers, organization, environment).
- 5) **Hazard Analyses** (task, process, facility)
 - a. Identification and analysis of hazards involved in the process and the assessment of risks including consideration of possible interactions between substances:
 - i. a team approach study or combination of studies, with a methodology appropriate to the complexity of the process, that address:
 - I) equipment failures
 - II) organizational errors
 - III) deviation from normal operational conditions
 - IV) chemicals compatibility and potential contamination
 - V) build-up of electrostatic charge and other ignition sources
 - VI) external events (e.g., utility failure, knock-on effects, vehicle impacts to process equipment, security concerns, and natural forces)
 - VII) inherent safety principles review
 - VIII) human factors engineering review:
 - A. task analysis or human error assessment
 - B. factors that influence human performance
 - IX) facility siting study, including land-use planning

- X) qualitative evaluation of risk
 - ii. evaluate the need for, and conduct as appropriate, quantitative (or semi-quantitative) analyses (e.g., risk scenarios; LOPA studies)
 - b. Hazard analyses shall be updated and revalidated by a team at least every 5 years.
- 6) **Procedures** (written instructions for safely conducting activities involved in a process such as safety, operating, emergency response, and maintenance procedures):
- a. Develop and implement procedures in accordance with human factors guidelines
 - b. Procedures should include or reference:
 - i. steps for each operating phase to be experienced
 - ii. operating limits consistent with the process safety information, and:
 - I) consequences of deviation and
 - II) steps required to correct or avoid deviation
 - iii. safety and health considerations:
 - I) properties of, and hazards presented by, the chemicals used in the process
 - II) precautions necessary to prevent exposure, including engineering controls, administrative controls, and personal protective equipment
 - III) control measures to be taken if physical contact or airborne exposure occurs
 - IV) quality control for raw materials and control of hazardous chemical inventory levels
 - V) any special or unique hazards
 - iv. safety systems and their functions
 - c. Ensure procedures are readily accessible to those who work in or maintain a process
 - d. Periodic certification (e.g., annually) that procedures are current and accurate.
- 7) **Training**
- a. Provide training to each employee currently involved in, and before being involved in a covered process activity, in:
 - i. overview of the process and the prevention program elements
 - ii. procedures applicable to each individual responsibilities with particular emphasis on the specific:
 - I) health, safety, environmental effects, and security of the organization's products and processes
 - II) safe work practices
 - III) emergency operations including shutdown (and the specific situations that would call for an immediate shutdown)
 - b. Refresher training to assure that the employee understands and adheres to current procedures:

- i. The employer, in consultation with the employees, will determine the appropriate frequency for each individual training (e.g., at least 3 years).
- c. Training documentation (also applicable for contractors):
 - i. Records that each employee has received and understood the training.
- 8) **Contractors** (those performing maintenance or repair, turnaround, major renovation, or specialty work on or adjacent to a covered process)
 - a. Host organization responsibilities:
 - i. obtain, evaluate, and periodically appraise information regarding the contract employer's safety performance and programs
 - ii. inform contract employers (and/or contract employees as applicable), of:
 - I) known potential hazards related to the facility and the contractor's scope of work
 - II) applicable provisions of the emergency action plans (EAP)
 - iii. evaluate performance of contractors in the field
 - b. Contract employer responsibilities (including subcontractors):
 - i. assure that each contract employee is trained in the work practices necessary to safely perform his/her job
 - ii. assure that each contract employee follows the safety rules of the facility
 - iii. maintain a contract employee injury and illness log
 - iv. advise the employer of any unique hazards presented by the contract employer's work, or of any hazards found.
- 9) **Mechanical Integrity** (needed to ensure the continued integrity of process equipment)
 - a. Compile and categorize a list of process equipment and instrumentation that upon failure can impact on, or affect, a release of a covered chemical in the process:
 - i. process equipment, such as:
 - I) pressure vessels and storage tanks
 - II) piping systems (including piping components such as valves, pumps)
 - III) relief and vent systems and devices
 - IV) Emergency shutdown systems;
 - V) controls (including monitoring devices and sensors, alarms, and interlocks) and,
 - VI) rotating equipment (including compressors, fans, agitators, blenders, etc.)
 - ii. use the process hazard analysis as a resource
 - b. Perform inspections and tests on process equipment:
 - i. follow good engineering practices
 - ii. document the results of each inspection or test
 - iii. establish the frequency of inspections and tests of process equipment according to:
 - I) applicable manufacturers' recommendations and GEPs

- II) prior operating experience or based on a predictive maintenance schedule
 - c. Deficiencies in equipment that are outside acceptable limits need to be corrected before further use or in a safe and timely manner:
 - i. when necessary, means are taken to assure safe operation
 - d. Quality assurance:
 - i. assure during the construction of new plants and equipment, that equipment as it is fabricated is suitable for the process application for which they will be used
 - ii. performed checks and inspections to assure that equipment is installed properly and consistent with design specifications and the manufacturer's instructions
 - iii. ensure maintenance materials, spare parts and equipment are suitable for the process application for which they will be used.
- 10) **Safe Work Practices**
- a. Develop and implement safe work practices (i.e., internal guidelines) to provide for the control of hazards during operations such as, but not limited to:
 - i. hot work
 - ii. lock-out/tag-out
 - iii. confined space entry
 - iv. opening process equipment or piping
 - v. control over entrance into a facility by support personnel
 - b. Establish a permit to work system for these non-routine operations, as needed and applicable (e.g., hot work permit).
- 11) **Management of Change (MOC)**
- a. Establish and implement written procedures to manage replacements not-in-kind and other modifications with regard to:
 - i. process chemicals, technology, and equipment
 - ii. storage of chemicals (e.g., amounts, containers, locations)
 - iii. procedures (to assure that they reflect current practice)
 - iv. changes to facilities or installations that affect a covered process
 - v. organizational changes (e.g., mergers, acquisitions, reorganizations, staffing levels, staff experience, budget cutting, etc.)
 - b. Prior to any change, a multidisciplinary review on the following is conducted:
 - i. technical basis for the proposed change
 - ii. impact of change on safety and health
 - iii. evaluation of the impact of changes on human factors
 - iv. modifications to operating procedures
 - v. necessary time period for the change
 - vi. authorization requirements for the proposed change.
 - c. Inform of, and train affected personnel (including contractors) in, the change, prior to:
 - i. start-up of the process or affected part of the process, or

- ii. working on the affected part of the process (e.g., following shift)
 - d. Update process safety information and procedures as appropriate for each change.
 - 12) **Pre-Startup Safety Review (PSSR)**
 - a. Ensure that:
 - i. prior to the introduction of hazardous chemicals to a process (i.e., for the first time)
 - ii. prior to the start-up of a new part of the process or unit
 - iii. prior to the start-up of a modified part of the process or facilities, where changes were significant enough to modify the PSI
 - b. A review is performed (e.g., via checklist) to confirm that:
 - i. construction and equipment are in accordance with design specifications
 - ii. PSI is available and has been updated to reflect the process as is
 - iii. procedures are in place and are adequate
 - iv. training of each affected employee has been completed
 - v. for new facilities, a process hazard analysis has been performed and recommendations have been resolved or implemented before startup.
 - 13) **Incident Investigation and Analysis**
 - a. Conduct investigations and analyses, as promptly as possible, for each incident which resulted in, or could reasonably have resulted in (i.e., a near miss), a loss of containment of a hazardous chemical. Team members should include:
 - i. knowledgeable individuals in the process involved, and analysis methodologies
 - ii. a contract employee if the incident involved work of a contractor
 - iii. other individuals with appropriate knowledge and experience to investigate and analyze the incident thoroughly
 - b. Prepare a report at the conclusion of the investigation and analysis which includes at a minimum:
 - i. date of incident and date investigation began
 - ii. description of the incident
 - iii. factors and root causes that contributed to the incident
 - iv. recommendations resulting from the investigation
 - c. Ensure human factors aspects are addressed:
 - i. measures for gathering information:
 - I) avoidance of blame
 - II) culture of openness
 - ii. include human factors that contributed to the incident in the analysis and report.
 - 14) **Emergency Planning and Response** (for the purpose of protecting employees, public health, and the environment)
 - a. Establish and implement an EAP that includes the following elements:

- i. proactive and periodic coordination with the community local emergency response officials, providing information necessary for developing and implementing the community emergency response plan
 - ii. procedures for handling small releases, including provisions on how to handle hazardous waste when applicable
 - iii. procedures for informing the public and local emergency services about accidental releases
 - iv. documentation of proper first-aid and emergency medical treatment necessary to treat accidental human exposures
 - v. procedures and measures for emergency response after an accidental release of a regulated substance
 - vi. procedures for the use of emergency response equipment and for its inspection, testing, and maintenance
 - vii. periodic testing and evaluation of their emergency planning procedures' effectiveness and revision as necessary
 - viii. periodic practice evacuation drills
 - b. Ensure the EAP and emergency response procedures address human factors:
 - i. assignment of responsibilities
 - ii. time requirements for decisions and actions
 - iii. task loads
 - iv. communications.
- 15) **Continuous Improvement** (audits, findings follow-up, documentation)
 - a. Periodic review and update:
 - i. ensure, through periodic research, the enhancement of process safety knowledge, and use of best available safety technologies and practices
 - ii. management system review to ensure the framework for managing risk continues to remain adequate, and avoids complacency
 - iii. audits (self-evaluations)
 - I) evaluate the prevention program periodically (e.g., at least every 3 years) to verify that the procedures and practices developed are adequate and are being followed.
 - II) develop a report of the findings of the audit
 - b. Follow-up:
 - i. establish a system to promptly address and resolve findings and recommendations (i.e., action items derived from PHAs, incident investigation, audits, and other elements of the program)
 - ii. assure that action items are resolved in a timely manner and
 - iii. communicate the actions to operating, maintenance, and other employees whose work assignments are in the process and who may be affected by the recommendations or actions.
 - c. Documentation; retain, at a minimum, the following records:
 - i. hazards analyses (updates or revalidations) reports for each applicable process

- ii. MOC forms (including supporting documentation for each change) and Incident Investigation reports:
 - I) retain reports for 5 years or until information is incorporated into the PHA (whichever occurs later)
 - iii. the two most recent audit reports
 - iv. the documented resolutions and corrective actions for action items of the program:
 - I) actions taken or to be taken
 - II) written schedule of when these actions are to be (or were) completed
 - III) date of, and individual responsible for, action item closure verification.
- 16) **Trade Secrets**
- a. Provide access to information necessary to comply with the prevention program, without regard to possible trade secret status, to individuals:
 - i. responsible for compiling the process safety information
 - ii. assisting in the development of the process hazard analysis
 - iii. responsible for developing, and using, process-related procedures
 - iv. involved in incident investigations, emergency planning and response, and audits
 - b. Confidentiality agreements may be used if needed, for employees and their designated representatives, not to disclose the information.

Appendix 20.F: Abbreviations Used in the Appendices

AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
BOEMRE	Bureau of Ocean Energy Management, Regulation, and Enforcement
CalARP	California Accidental Release Prevention
CCPS	Center for Chemical Process Safety
EPA	Environmental Protection Agency
GEP	Good Engineering Practice
HSE	Health and Safety Executive
ICCA	International Council of Chemical Associations
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ILO	International Labour Organization
ISA	International Society of Automation
ISO	International Organization for Standardization
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
OECD	Organization for Economic Co-operation and Development
OSHA	Occupational Safety and Health Administration

PEMEX	Petróleos Mexicanos (State-owned oil company, Mexico)
RP	Recommended Practice
STPS	Secretaría del Trabajo y Previsión Social (Labor Department, Mexico)
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environmental Program

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