Benefits of Regulation for Chemical Accident Prevention, Preparedness and Response

PRESENTING THE CASE FOR SENIOR POLICYMAKERS AND OTHER STAKEHOLDERS

Series on Chemical Accidents

OECD

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The Environment, Health and Safety Division publishes free-of-charge documents in twelve different series: **Testing and Assessment**; **Good Laboratory Practice and Compliance Monitoring**; **Pesticides**; **Biocides**; **Risk Management**; **Harmonisation of Regulatory Oversight in Biotechnology**; **Safety of Novel Foods and Feeds; Chemical Accidents; Pollutant Release and Transfer Registers; Emission Scenario Documents; Safety of Manufactured Nanomaterials;** and **Adverse Outcome Pathways.** More information about the Environment, Health and Safety Programme and EHS publications is available on the OECD's World Wide Web site (https://www.oecd.org/en/topics/chemical-safety-and-biosafety.html).

This publication was developed in the IOMC context. The contents do not necessarily reflect the views or stated policies of individual IOMC Participating Organizations.

The Inter-Organisation Programme for the Sound Management of Chemicals (IOMC) was established in 1995 following recommendations made by the 1992 UN Conference on Environment and Development to strengthen co-operation and increase international co-ordination in the field of chemical safety. The Participating Organisations are FAO, ILO, UNDP, UNEP, UNIDO, UNITAR, WHO, World Bank, Basel, Rotterdam and Stockholm Conventions and OECD. The purpose of the IOMC is to promote co-ordination of the policies and activities pursued by the Participating Organisations, jointly or separately, to achieve the sound management of chemicals in relation to human health and the environment.

Foreword

Countries around the world have been setting up legal frameworks to address the prevention, preparedness and response to chemical accidents. The main driver for new regulations or changes to existing regulations has been the recurrence of chemical accidents with serious consequences on human health, the environment and property. Chemical accidents with serious consequences are still happening in OECD countries and worldwide. The purpose of this document is to provide background information on why regulations in this field are important, and how effective regulations can be developed.

This publication is the result of a collaborative effort within the OECD Working Party on Chemical Accidents who input to and reviewed the document. The document was developed under the leadership of Canada, Jessy Kurias and Pierre Manseau, Environment and Climate Change Canada, with the support of a drafting group of experts including: Mark Hailwood, State Institute for the Environment Baden Württemberg, Germany, Rachel McCann, Health and Safety Executive, United Kingdom and Maureen Wood, Joint Research Centre of the European Commission, and the OECD secretariat Marie-Ange Baucher and Eeva Leinala.

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1 Audience and purpose

Countries around the world have been setting up legal frameworks to address the prevention, preparedness and response to chemical accidents and yet, chemical accidents with serious consequences continue to happen in OECD Member countries and worldwide. Over the past decades, major accidents have caused deaths, injuries, significant environmental pollution and massive economic losses. Even so, the consequences of policy inaction are still insufficiently understood by many decision-makers. Assessment of regulations can be considerably improved by better understanding the drivers of regulations and the benefits of these regulations.

The purpose of this document is to provide background information to support the case for why regulations in this field are important and how effective regulations can be developed. This document is aimed at senior policymakers who have a need for supporting information to:

- justify the development of effective regulations for chemical accident prevention, preparedness and response;
- justify the enhancement of existing chemical accident prevention, preparedness and response regulations;
- ensure continuous support for existing chemical accident prevention, preparedness and response regulations.

In this publication, senior leaders refer to personnel who have decision-making authority and/or who contribute to decision-making within a government.

This document applies to regulations for chemical accident prevention, preparedness and response. In the framework of this document, chemical accident is referred to as any unintentional event, such as a release, fire or explosion at a hazardous installation, involving hazardous substances, that has the potential to cause harm to human health, the environment or property.

This document addresses fixed installations as well as pipelines and transport interfaces such as marshalling yards and port areas, with the exclusion of military or nuclear installations. This report does not specifically address the entire subject of transport of dangerous goods per se (e.g., by road, rail, ships, planes). However, many of the provisions of this publication are relevant to the prevention of, preparedness for, and response to transport accidents and could prove very helpful to those involved in transport-related activities.

2 Motivations for regulating

Chemical accidents continue to happen

Although largely preventable, chemical accidents that result in death, injuries, serious environmental consequences and impacts on property continue to occur. Hundreds of people die every year from chemical accidents around the world. It is not acceptable for the public to endure recurring chemical accidents given the current level of knowledge, technology and expertise available in the world:

- Existing knowledge should be applied throughout the world regardless of the degree of industrialisation;
- Regulations setting out requirements of the industry and responsibilities of the authorities should be established;
- Oversight and enforcement should take place.

The responsibility to keep people safe and protect the environment and property

The consequences of chemical accidents can be harmful to human health, the economy and the environment with dramatic impacts on the quality of life of individuals and affected communities. The physical and psychological harm, and the economic and legal costs of chemical accident risks are high and can be far-reaching.

Governments should ensure that chemical accidents from hazardous installations do not cause harm to human health, the environment or property. Society relies on government leaders to live up to this expectation and to be accountable if they do not.

Governments should ensure that hazardous installations are designed, constructed and operated in such a way so that the risks to employees, the surrounding community and the environment from a chemical accident are as low as reasonably practicable[1]. In addition, measures should be adopted on-site and off-site to prepare for any accident should it occur, so as to be able to respond in an appropriate manner. To achieve these goals, governments should develop overall safety objectives, adopt chemical accident programmes, effective regulations and consider inspection and enforcement regimes.

Providing a minimum standard

Effective regulations define a minimum set of expectations and behaviours with which industry should comply. They can also set out processes by which public authorities will carry out inspection and enforcement activities to gain assurance that these criteria are being fulfilled. The operator of an installation

[1] The concept of 'as low as reasonably practicable' involves weighing a risk against the effort, time and money needed to control the risk and the alternative means of managing that risk.

should be responsible for managing risks to a level as low as reasonably practicable. Moreover, they should be aware that, in the event of a chemical accident, they should have prepared an emergency plan to respond to the accident. Public authorities should establish compatible off-site emergency plans to deal with these events.

Effective regulations aim to develop mechanisms that will ensure that the hazards which may lead to a chemical accident are identified and their risks are managed appropriately. Implementation of these regulations is based on a collaboration and exchange between public authorities and industry.

Establishing a level playing field - Consistency of regulation

Regulations should apply to operators of installations handling hazardous substances in a consistent manner. This means that the same requirements should be applied irrespective of the geographical location, type of industry, and public or private operator. This ensures that there is no economic benefit in avoiding effective chemical accident risk management.

Box 2.1. Existing regulations for chemical accident prevention, preparedness and response

Existing regulations for chemical accident prevention, preparedness and response have mainly been developed:

- **as a reaction to major accidents** that occurred within a jurisdiction or elsewhere. The underlying motivation being that the major accident should not occur again;
- **from observing what current good practices** are amongst similar countries;
- **as a result of joining, intending to join or aligning with a supranational or inter-governmental organisation** (e.g. European Union, OECD), and adopting their respective legal instruments.

One of the biggest influences on updating and modernising chemical accident regulations in recent years has been the adoption, in 2019, of the eighth edition of the UN Globally Harmonised System for classification, labelling and packaging of chemicals. Establishing this system by which the hazards of particular chemicals can be classified means that it is possible to have a consistent communication and understanding of these hazards around the world.

3 Learning from chemical accidents

The main driver for new regulations or changes to existing regulations has been the recurrence of chemical accidents with serious consequences for the workers, the surrounding neighbourhood, or the environment coupled with concerns linked to growing industrialisation (see Table 3.1 and Annex A History of Regulations related to Chemical Accidents). These chemical accidents often resulted in a massive and widespread public outcry that prompted local governments to act.

Chemical accidents across the world often serve as cautionary lessons to governments. It is critical for public authorities to understand and communicate, to the public and political leaders, the consequences of chemical accidents resulting from a lack of regulation, failure to develop effective regulations, or failure to enforce regulations.

It should also be noted that there have been numerous major accidents for which no immediate legislative response can be attributed. However, not all major accidents and disasters require changes to regulation. Instead, improved compliance with existing regulations together with more effective inspection and enforcement regimes may also provide substantial improvements in safety performance.

Table 3.1. Examples of chemical accidents prompting legislative responses

Year	Location	Accident	Legislative Response
1974	Flixborough, United Kingdom	A large release of hot cyclohexane led to a vapour cloud explosion. Of the 72 persons on site 28 were killed and 36 injured. Many injuries occurred off-site and over 200 homes were damaged.	**Europe**: In the UK, the Advisory Committee on Major Hazards was established and the *Notification of Installations Handling Hazardous Substances Regulations* 1982 were issued under the *Health and Safety at Work Act*
1976	Seveso, Italy	A release of 6 tonnes of chemicals from an exothermic runaway reaction at a chemical plant. This release included ca. 1 kg of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). This led to the contamination of 18 km² of the surrounding area.	**Europe:** Passing of the *Seveso Directive* in 1982 by the European Economic Community, which required Member States to adopt provisions to ensure that manufacturers take all measures necessary to prevent major accidents and to limit their consequences for man and the environment. Further provisions required the development of safety reports, the setting up of inspections, provision of information to potentially affected public, and reporting of major accidents.
1979	Mississauga, Canada	Styrene, toluene, propane, sodium hydroxide, and chlorine released from chemical tanks ruptured in a freight train derailment. This led to the evacuation of 200 000 people.	**Canada:** Led to the adoption of regulations related to the transportation of dangerous goods, including the requirement for measures to respond to transportation accidents involving high risk chemicals
1984	Bhopal, India	Methyl isocyanate (gas) released from a storage tank at the Union Carbide India Limited works	**United States:** triggered the Risk Management Program Rule **Europe:** The scope of the *Seveso Directive* was amended to extend the types of installations covered as well as the list of chemical substances, respectively to lower the thresholds for some substances. **Canada:** triggered non-regulatory measures for chemical accident prevention.
1986	Schweizerhalle, Switzerland	Release of insecticides and pesticides into the Rhine River from a fire in a Sandoz warehouse	**Switzerland:** Led to the enactment of the *Major Accidents Ordinance* **Europe:** The *Seveso Directive* was amended to reinforce the communication of information to the public and to widen the scope of the Directive by listing further chemicals in the relevant annexes, in particular chemicals to be found in agrochemical manufacturing and storage. **UNECE:** led to the development of the Transboundary Effects of Industrial Accidents convention (TEIA)
1988	United Kingdom	A fire and explosion on the Piper Alpha offshore oil platform that killed 165 of the men on board and 2	**United Kingdom:** A public enquiry led by Lord Cullen published recommendations leading to the enactment of the *Offshore Safety Act* 1992 and the making of the *Offshore Installations (Safety*

		rescue workers. Sixty-one survived.	*Case) Regulations* 1992
1998	Longford, Australia	Failure of a heat exchanger at an Esso natural gas plant leading to a massive release of hydrocarbons followed by an explosion and fire. Two workers were killed, and eight others injured. The natural gas supply for the State of Victoria was severely disrupted for two weeks.	**Australia:** Led to the development of the *Occupational Health and Safety (Major Hazard Facilities) Regulations* 2000 in the State of Victoria
2000	Baia Mara, Romania	Waste contaminated with cyanide and heavy metals released into tributaries to the Tisza and the Danube Rivers from a collapse of a gold mine tailings dam	**Europe:** The *Seveso II Directive* was adopted by the Council of the European Union in 1996. The most fundamental change being that the scope did not address individual installations but rather sites or establishments. Further to this, the scope was mainly defined by classifications of dangerous substances in place of a long list of named substances. As a result of the Baia Mara accident, the *Seveso II Directive* was amended in 2003 to clarify the scope regarding the minerals extraction industry and their related processes.
2001	Enschede, Netherlands	Explosion at a fireworks storage depot. 177 tonnes of fireworks exploded destroying the surrounding area	**Europe:** The *Seveso II Directive* was amended in 2003 with more stringent provisions regarding land-use planning. Also, the requirements for the development of a Safety Report were strengthened and more closely specified. The scope of the Directive was amended regarding ammonium nitrate to take account of various types of ammonium nitrate and the risks associated with them.
2001	Toulouse, France	Explosion at the AZF fertilizer factory. Three hundred tonnes of ammonium nitrate exploded destroying the entire factory. The explosion created a crater of 7 m depth and 40 m diameter. 31 people were killed, 30 seriously injured and about 2500 lighter casualties. Two thirds of the city's windows were shattered. Around 10% of the inhabitants of Toulouse had to be evacuated	
2005	Texas City, US	A series of explosions occurred at the BP Texas City refinery during the re-start of a hydrocarbon isomerization unit. Fifteen workers were killed, and 180 others were injured. Many of the victims were in or around work trailers located near an atmospheric vent stack. The explosions occurred when a distillation tower flooded with hydrocarbons and was over pressurized, causing a geyser-like release from the vent stack. The direct cause of the accident was the ignition of a heavy hydrocarbon vapor cloud which emanated from raffinate liquids overflowing from the top of a blowdown stack. The source of ignition was	Whilst not leading to specific legislative changes, there were a number of investigations and reports which highlighted not only technical deficiencies but also organizational and management failings at local and corporate level. The reports included: • The Mogford Report - Fatal Accident Investigation Report – Isomerization Unit Explosion • The Baker Panel Report - The Report of the BP U.S. Refineries Independent Safety Review Panel • The Telos Group Report - BP Texas City Site Report of Findings – Texas City's Protection Performance, Behaviors, Culture, Management, and Leadership • Bonse-Geuking et al Report -Management Accountability Project: Texas City Isomerization Explosion • The US Chemical Safety Board (CSB) Investigation - Investigation Report: Refinery Explosion

		probably a running vehicle engine. The release of liquid followed the automatic opening of a set of relief valves on a raffinate splitter column caused by overfilling.	and Fire (15 Killed, 180 Injured) The CSB Investigation also found that there was a lack of regulatory oversight with insufficient inspections and enforcement by both US OSHA and US EPA. This underlines that regulation alone is insufficient and requires appropriate oversight and enforcement together with the necessary resources.
2010	Pike River Mine, New Zealand	Methane explosion in a coal mine resulting in the deaths of 29 workers	**New Zealand**: Triggered a reform of the health and safety system, which resulted in the establishment of *WorkSafe New Zealand* and the *Health and Safety at Work Act 2015*. This included the introduction of regulations for the installations storing large quantities of hazardous substances, *Health and Safety at Work (Major Hazard Facilities) Regulations 2016*.
2010	Gulf of Mexico, US	The Deepwater Horizon drilling rig explosion and fire resulted in the deaths of 11 workers and the injury of 17 others, as well as the loss of the drilling rig. The blowout, which led to the explosion, caused an oil well fire and a massive offshore oil spill.	**US:** Improvement in the funding of the monitoring and inspection of offshore exploration. In 2011, the Secretary of the Department of the Interior (DOI) redefined the responsibilities previously performed by the Minerals Management Service (MMS) and reassigned the functions of the offshore energy program among three separate organizations: the Bureau of Ocean Energy Management (BOEM), the Bureau of Safety and Environmental Enforcement (BSEE), and the Office of Natural Resources Revenue (ONRR). These DOI Agencies issued several regulations to improve safety and reduce the impacts of accidents. **Europe:** the EU issued the Directive on safety of offshore oil and gas operations in 2013.
2012	Gu-Mi City South Korea	Explosion during the unloading of hydrogen fluoride from a road tanker caused 8 tonnes of HF gas to leak into the surrounding area.	**South Korea:** Regulations strengthened to cover additional substances (accident precaution chemicals) under the *Chemical Control Act* 2015, which replaced the *Toxic Chemicals Control Act*.
2017	Israel	Fireworks warehouse explosion led to the death of two workers and caused damage to property and residential houses	**Israel:** A regulation based on international guidelines has been established for safe fireworks handling and storage.

4 Benefits of regulations – decreasing consequences of chemical accidents and increasing benefits to humans, environment and economy

The consequences of chemical accidents include deaths, serious injuries, significant environmental damage, disruption to critical supply chains and damage to the economic viability of a facility and the local community. Countries have been developing regulations over the years with the goal of preventing, preparing and responding to chemical accidents (see Table 4.1)

The benefits of effective regulation include the reduction of chemical accident risks at hazardous installations. By reducing the opportunity for chemical accidents to occur and the probability of consequences to people, the environment and property, this improves the safety, health and well-being of society in general (see Figure 4.1).

The public and the communities surrounding hazardous installations have a right to be informed about the chemical accident risks in their area. Effective chemical accident regulations help increase the public's knowledge and access to information on chemicals at facilities, their uses, and releases into the environment. Communities, working with facilities, can use the information to improve chemical safety and protect their health and their environment.

Chemical accidents are resource intensive in terms of both the personnel and equipment of first responder organisations. This includes the actual response to the accident and any services required over the following days for recovery efforts, evacuations, traffic control and policing. Chemical accident regulations require multi-stakeholder co-ordination and co-operation for effective emergency response with first responder organisations (i.e., firefighters, police, ambulance services and hospitals).

For workers, chemical accidents can result in loss of income from workplace closures (permanent or temporary) and/or loss of health due to illness or injuries. When chemical accidents result in fatalities, the primary victims are often workers and/or first responders. Fatalities may also occur because of long-latency illnesses due to the exposure to hazardous chemicals. Such exposure may result in short-term (e.g., skin diseases and asthma) and/or long-latency illnesses (e.g., chronic obstructive pulmonary diseases and cancers). Chemical accidents also can result in psychological trauma to employees, first responders and the public witnessing the accident. Effective chemical accident regulations can reduce workplace injuries, illnesses, and reduce the costs associated with these injuries and illnesses, including workers' compensation payments, medical expenses and lost productivity.

For the environment, chemical accidents can result in the release of hazardous chemicals into the air, soil, water, drinking water and groundwater with adverse impacts to agriculture, fisheries, flora and fauna. This release of hazardous chemicals can cause habitat destruction, loss of biodiversity, loss of wildlife, as well as contaminating drinking water and food supplies. The release of hazardous chemicals through air and water can also result in widespread impacts well beyond the chemical accident's original physical boundaries. And while air pollution might dissipate over time, groundwater and soil contamination are more likely to remain localised. The clean-up and restoration of wildlife habitats that have been environmentally degraded is costly, as are measures to re-locate human populations whose food and water sources have become contaminated.

For the economy, chemical accidents can damage or destroy infrastructure within and around the affected site. Infrastructure includes transportation networks, schools, health service facilities, and utilities such as energy, water and wastewater. Chemical accidents can damage and destroy local housing and businesses and require the evacuation, displacement (temporary or permanent) of part of or all the local community. The damage to critical infrastructure affects the production of local goods and services, in terms of both availability and the efficiency of production. These impacts encompass the local economy (e.g., loss of production, loss of education, loss of tourism) and the broader economy (e.g., national supply chain disruptions, loss of exports, increased imports). Other economic losses include:

- loss of business revenue due to business interruption;
- loss of tax revenues;
- loss of income;
- interruptions to transportation networks and supply chains;
- unemployment;
- cost increases for the provision of essential services;
- increases in government debt;
- costs paid by industry and government for response, clean-up, and restoration;
- negative impact on share prices.

For the company, repercussions include damage to company property, death and/or personal injuries of workers, and temporary closure of the workplace. Moreover, the chemical accident itself, its causes, as well as the way the company managed the aftermath of the chemical accident may affect the company's image, reputation, brand and share value. Legal costs are unavoidable through the litigation of lawsuits from victims, affected communities and any regulatory fines. This can make the companies liable for higher losses in the event of an chemical accident and could ultimately result in bankruptcy if insurance coverage is not adequate. Large financial losses and insurance pay outs can weaken a company's financial state, making them susceptible to a hostile takeover or forced receivership. Additionally, senior company executives can face criminal trials for negligence.

Figure 4.1. Benefits of Regulations – Decreasing the Consequences of Chemical Accidents and Increasing the Benefits to Humans, Environment and the Economy

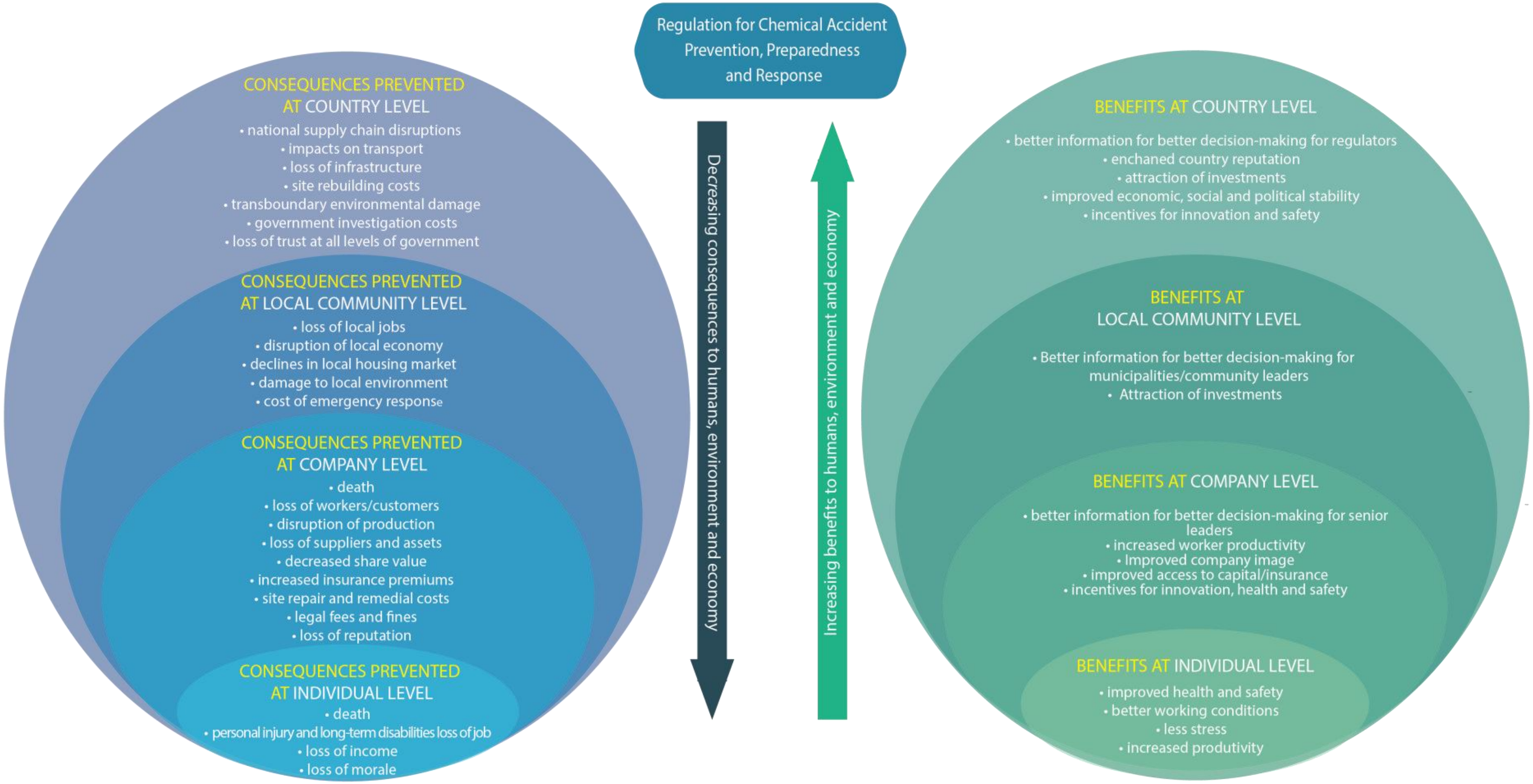

Table 4.1. Examples of countries with chemical accident and prevention programmes

Canada	*Environmental Emergency Regulations*, 2019: CEPA Registry - Canada.ca
Colombia	Decree 2157, 2017: Disaster Risk Management Plan for Public and Private Entities: https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=199583 National Contingency Plan for Loss of Containment of Hydrocarbons and Other Dangerous Substances: https://portal.gestiondelriesgo.gov.co/Documents/PNC/PNC-frente-a-perdidas-de-contencion-de-hidrocarburos-y-otras-sustancias-peligrosas-2021.pdf Major Accident Prevention Program: https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=173043 Disaster Risk Management Policy for the Mining and Energy Sector: https://www.minenergia.gov.co/documents/9294/3._Pol%C3%ADtica_de_Gesti%C3%B3n_del_Riesgo_de_Desastres_del_SME.pdf National maximum individual accidental risk values for fixed installations: https://portal.gestiondelriesgo.gov.co/Documents/Resoluciones/RESOLUCION-0559-24-JUNIO-2022.PDF
Israel	Poison permit's regulation demands היתר רעלים המשרד להגנת הסביבה Policy of separation distances from stationary risk sources מדיניות מרחקי הפרדה ממקורות סיכון נייחים המשרד להגנת הסביבה Integrated risk management policy to prevent hazardous materials events ניהול סיכונים למניעת תקריות חומרים מסוכנים המשרד להגנת הסביבה Policy for preventing cyber events in the industry מדריכי סייבר: עמידה בתנאים של היתר רעלים בתחום הסייבר בתעשייה גרסה 1.3 וגרסה 2.0 המשרד להגנת הסביבה Clean air law חוק אוויר נקי, התשס"ח-2008 המשרד להגנת הסביבה
Japan	*Fire Service Act*: https://www.japaneselawtranslation.go.jp/en/laws/view/3772 *High Pressure Gas Safety Act*: https://www.japaneselawtranslation.go.jp/en/laws/view/4555 *Regulation on Safety of Containers*: https://www.japaneselawtranslation.go.jp/en/laws/view/4273 *Industrial Safety and Health Act*: https://www.japaneselawtranslation.go.jp/en/laws/view/3440 *Basic Act on the Environment*: https://www.japaneselawtranslation.go.jp/en/laws/view/3850 *Air Pollution Control Act*: https://www.japaneselawtranslation.go.jp/en/laws/view/4601 *Water Pollution Prevention Act*: https://www.japaneselawtranslation.go.jp/en/laws/view/2815 [In Japanese] *Act for the Prevention of Disasters at Petrochemical Complexes*, etc.: https://elaws.e-gov.go.jp/document?lawid=350AC0000000084 *General High Pressure Gas Safety Regulations*: https://elaws.e-gov.go.jp/document?lawid=341M50000400053 *LPG safety regulations*: https://elaws.e-gov.go.jp/document?lawid=341M50000400052
New Zealand	*Health and Safety at Work (Major Hazard Facilities) Regulations* 2016 https://www.legislation.govt.nz/regulation/public/2016/0014/latest/DLM6243901.html *Health and Safety at Work (Hazardous Substances) Regulations* 2017 https://www.legislation.govt.nz/regulation/public/2017/0131/latest/DLM7309401.html *Health and Safety at Work (Mining Operations and Quarrying Operations) Regulations* 2016 https://www.legislation.govt.nz/regulation/public/2016/0017/latest/DLM6732829.html *Health and Safety at Work (Petroleum Exploration and Extraction) Regulations* 2016 https://www.legislation.govt.nz/regulation/public/2016/0018/latest/DLM6728801.html
United States	*Clean Air Act* (Section 112(r) of the Clean Air Act Amendments): Clean Air Act Text | US EPA EPA Risk Management Program (40 CFR Part 68): eCFR :: 40 CFR Part 68 -- Chemical Accident Prevention Provisions OSHA Process Safety Management (29 CFR 1910.119): https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.119 *The Emergency Planning and Community Right-to-Know Act* (EPCRA) (42 U.S.C. 11001 et seq. (1986)): What is EPCRA? | US EPA *Clean Water Act Hazardous Substances Facility Response Plans (Section 311(j)(5) and 501(a) of the CWA), 40*

	CFR Parts 118 and 300 : eCFR :: 40 CFR Part 118 – Clean Water Act Hazardous Substances Facility Response Plans
European Union	*Seveso III Directive*: https://eur-lex.europa.eu/eli/dir/2012/18/oj National transposition measures communicated by the Member States: https://eur-lex.europa.eu/legal-content/EN/NIM/?uri=CELEX:32012L0018 Environmental liability Directive: https://eur-lex.europa.eu/eli/dir/2004/35/2019-06-26

5 Key considerations in developing effective regulations

Effective chemical accident prevention, preparedness and response regulation can generate benefits at all levels of society from individuals, such as employees or local residents, to the national or international level including companies. These benefits can be both qualitative and quantitative. Indeed, some benefits can be challenging to quantify as the primary benefits are avoiding the negative consequences of accidents, and it is difficult to demonstrate the benefits of something not happening. However, the quantifiable economic costs of past accidents can be used to inform decision-making.

Public authorities should consider identifying clear objectives before beginning to design and implement a chemical accident prevention, preparedness, and response programme, and determine how success against those objectives can be measured as a means of demonstrating the benefits of an effective regulatory framework. A lack of clear objectives can lead to a poorly defined scope, unclear requirements, and uncertainty for all stakeholders, which may lead to the intended benefits not being realised.

It is not possible to apply a simplistic advantages and disadvantages approach to “goal setting” or “prescriptive” regulation. Different approaches and tools should be considered in the context of how they contribute towards overall policy goals. There is more flexibility for operators to achieve compliance with a “goal setting” regulation, but they will have to demonstrate this to the public authorities. There is less flexibility for operators to comply with “prescriptive” regulations, but this type of regulation is often more easily assessed by public authorities.

“Goal setting” requirements may be considered where:

- The regulations apply to a wide range of different installations;
- The possible means of achieving the goals are varied and are dependent on multiple factors, for example size and complexity of the facility.

“Prescriptive” requirements may be considered where:

- The specific requirement applies to all installations within the scope of the regulation;
- There are fewer possible means of achieving the goal, and possibly agreed-to national or international standards.

Regulations should not lead to duplication of requirements placed upon an operator. Any possible duplication should be dealt with within the regulations; for example, by recognizing that compliance with one regulation at a higher level automatically ensures compliance.

Effective regulation should have clear goals which can be used to set a minimum standard for compliance and should not generate excessive burdens for companies or public authorities. Public authorities must be able to inspect and enforce the defined standards, designate authorities to local authorities, and provide political leaders with assurance that hazards are being well managed. There should also be meaningful enforcement procedures ensuring that companies are not able to gain economic advantage through non-compliance.

The US Environment Protection Agency has developed a Regulatory Impact Analysis to revise its Risk Management Program in which it uses both the costs of previous chemical accidents, and it also provides five broad social benefit categories for the new provisions (which could not be monetized) related to accident prevention and mitigation (see Box 5.1).

Box 5.1. 2024 Rulemaking under the United States Environment Protection Agency's Risk Management Program (RMP): Safer Communities by Chemical Accident Prevention

In February 2024, the United States Environment Protection Agency (EPA) released the Safer Communities by Chemical Accident Prevention rule, which finalizes revisions to the Risk Management Program (RMP) with the goal to further protect vulnerable communities from chemical accidents, as RMP accidents continue to occur.

The final rule includes new provisions such as identifying safer technologies and chemical alternatives, consideration of natural hazards and power loss, facility siting evaluation, employee participation, improvements to the public availability of chemical hazard information, more thorough incident investigations, and third-party auditing. To develop this new rule, the EPA performed a Regulatory Impact Analysis (RIA), with which it estimated annualised final rule costs of $256.9 million at a 3% discount rate and $296.9 million at a 7% discount rate over a 10-year period. The EPA also estimated a five-year baseline period accident cost of $540 million per year. This cost was estimated using impacts from chemical accidents during 2016 through 2020 reported to the RMP plan reporting database by facility owners and operators.

The EPA expects the final rule provisions to result in a reduced frequency and magnitude of damages from releases, including damages that are quantified for the baseline period such as fatalities, injuries, property damage, hospitalizations, medical treatment, sheltering in place, and evacuations, and damages that are not quantified. These damages include potential health risks from toxic chemical exposure, lost productivity at affected facilities, emergency response costs, property value losses in nearby neighbourhoods, environmental damage and costs of evacuation and sheltering-in-place events. In some cases, these damages could be even more detrimental to the facility and community than those damages that can be quantified. With this calculation, preventing a single high-cost accident annually would offset annual rule costs.

The RIA also provided five broad social benefit categories for the new provisions, which could not be monetized, related to accident prevention and mitigation, including prevention of RMP accidents, mitigation of RMP accidents, prevention and mitigation of non-RMP accidents at RMP facilities, and prevention of major catastrophes. Categories of social benefits include: prevention and mitigation of both future RMP and non-RMP accidents at RMP facilities and avoiding major catastrophes, as well as long-term health risks from exposure to toxic chemicals, lost productivity, responder costs, transaction costs, environmental impacts and unquantified evacuation and shelter-in-place costs.

Source: US EPA (2024), Accidental Release Prevention Requirements: Risk Management Programs Under the Clean Air Act; Safer Communities by Chemical Accident Prevention, https://www.federalregister.gov/documents/2024/03/11/2024-04458/accidental-release-prevention-requirements-risk-management-programs-under-the-clean-air-act-safer

6 Key considerations for evaluating the benefits of regulations

The US Chemical Safety Board investigation of the 2005 Texas City (US) accident (see Table 3.1) indicated a lack of regulatory oversight with insufficient inspections and enforcement by both US OSHA and US EPA. This underlines that effective regulation alone is insufficient and requires appropriate oversight and enforcement together with the necessary resources. For existing or unchanged regulations, a stock review or audit of the regulations ensures that regulations are fit for purpose and continue to yield net benefits to society. The OECD 2020 Reviewing the Stock of Regulation states that member countries should "*conduct systematic reviews … to ensure that regulations remain … cost effective and consistent and deliver the intended policy objectives*"[2]. Essential questions to be answered include:

- whether a valid rationale still exists for regulating (appropriate),
- whether regulations achieved their objectives (effectiveness),
- whether they have given rise to unnecessary costs or other unintended impacts (efficiency), and, ultimately,
- whether amendments, removal or replacement of the regulations are needed.

Reporting and analysing chemical accidents and near misses

To assess the appropriateness, effectiveness, and efficiency of chemical accident regulation, data is needed to inform regulatory decision-making. A country's regulatory framework provides the platform necessary for continued dialogue, cooperation, and data-sharing between the responsible authority and the company. However, it is the responsibility of the responsible authority to set up information management systems to collect, catalogue and maintain up-to-date data on hazardous installations and their chemicals to assess risks, determine priorities, and improve safety. Data allows responsible authorities to perform analyses that can facilitate dealing with emerging issues, measure performance, assess regulatory effectiveness and determine whether regulatory changes are required. For example, information on the frequency and number of near misses[3] (which might not be available in the absence of regulations) can prompt additional regulatory activities. In the event of a near miss, the relevant information (e.g., types and quantities of substances released, installations involved, root causes and contributing factors, consequences on human health, the environment and property, emergency response actions taken) can signal an authority to direct resources towards on-site inspections as well as enabling

2 OECD (2020), *Reviewing the Stock of Regulation*, OECD Best Practice Principles for Regulatory Policy, OECD Publishing, Paris, https://doi.org/10.1787/1a8f33bc-en.

3 Near miss incident: *The description of less severe incidents (i.e., below the threshold for inclusion in a lagging metric), or unsafe conditions that activated one or more layers of protection. Although these events are actual events (i.e., a lagging metric), they are generally considered to be a good indicator of conditions that could ultimately lead to a severe incident, see* https://www.aiche.org/ccps/resources/glossary/process-safety-glossary/near-miss-incident

responsible authorities to assess the effectiveness of their regulations in reducing chemical accidents. Companies have the responsibility to provide data to allow responsible authorities to understand the nature and extent of potential risks at a site.

Auditing the existing regulatory framework - how does the proposed regulation fit with existing regulation?

The UNEP Flexible Framework Initiative for Chemical Accident Prevention and Preparedness[4] defines what good governance should achieve for chemical accident regulations. The '**Review and Revision Phase'** of the Flexible Framework incorporates a stock review or audit**.** This phase is part of the cycle for continuous regulatory improvement where regulatory excellence is driven by data gathering, data analysis and performance measurement. Questions asked in this phase to assess the performance of the chemical accident regulation and improve its appropriateness, effectiveness and efficiency include:

- Has a review or audit been conducted for the regulation? What worked and what didn't work?
- Has there been a shift in governmental priorities? Should the programme be expanded or amended considering any changes in the level or nature of risk, availability of resources, and experience gained, or new and emerging industries?
- Did the regulation achieve its objective? Have performance indicators been established and what do they indicate?
- Does the regulation fit with other existing regulation? Are there competing or duplicative regulatory requirements within the country?
- Do the regulations meet international obligations?
- What is the regulatory burden on the industry (from small to large businesses) compared to the risk that they present from their activities?
- How many chemical accidents were reported? How many near misses were reported? What were the lessons learned and were the lessons implemented?
- What do the inspection and enforcement activities show? What were the weaknesses, deviations, and rate of compliance?

Data requirements can be based on a tiered, i.e., proportionate approach, where hazardous installations with an associated higher level of risk are required to provide more information to demonstrate that adequate chemical accident prevention policies and safety management systems have been implemented. Data necessary to responsible authorities include information to help prioritize enforcement activities such as inspections, land-use planning or co-ordinating off-site with on-site preparedness planning. Responsible authorities can develop an inspection programme, together with a prioritization strategy (e.g., considering available resources, the number and size of hazardous installations and the information available for each installation) to ensure regulatory compliance and ultimately, minimize and mitigate the consequences of chemical accidents. Thus, a regulatory framework allows for accountability and public investigations if a major chemical accident occurs.

Performance indicators - does it fulfil the regulatory intention?

As part of a continuous improvement and evaluation process, tools such as performance measurement are used to measure the performance and effectiveness of regulations. Performance measurement is an

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[4] UNEP(2010), A Flexible Framework For Addressing Chemical Accident Prevention And Preparedness, UN_Flexible_Framework_USE.indd

approach aimed at continuously measuring and reporting on a regulation's progress and accomplishments, using pre-selected performance indicators. Responsible authorities can then directly gauge whether a regulation is meeting its goals and objectives. Performance indicators can identify areas of increasing or decreasing performance that may warrant further investigation. Performance indicators can lead to improvements because they raise awareness and improve understanding of safety-related issues. Responsible authorities should assess if the activities required by the regulation are being carried out and whether their desired level of performance is being achieved.

Some examples of performance indicators include:

- Reducing the frequency of accidents and near-misses, and their severity.
- Reducing injuries and fatalities
- Reducing environmental impacts
- Improving response times to chemical accidents
- Reducing the impact zone of chemical accidents (distance).

Assessment of inspection and enforcement activities by authorities

Regulatory inspection and enforcement activities are found throughout all levels of government. The primary objective is to ensure compliance with the legislation, regulations and policies. To fulfil this objective, responsible authorities must develop effective inspection, compliance and enforcement programmes. Generally, in the standard Plan-Do-Check-Act Management Model (see Figure 6.1), inspection and compliance programmes contain the following components:

- **Identify the regulated population** covered by the legislation, regulation or policy according to characteristics such as size, type of industry or presence of major risk factors;
- A **monitoring plan** that lays out how compliance will be monitored. This plan is based on a risk assessment and include inspection or audit strategies (for example, scope of the inspection) and information requirements (for example, documents or data submitted by companies);
- **Implement the monitoring plan** through inspections, audits, review of documents submitted, etc;
- **Make decisions on whether compliance has been achieved** or whether action is required. Potential actions could include sending warning letters indicating remedial steps to be taken, enforcing penalties, filing charges through the court system, or shutting down non-compliant operations;
- **Take action** by implementing the decisions noted in the step above;
- **Report** various aspects of programme performance including statistics and financial measures;
- **Follow-up action** to ensure violators have completed action requirements;
- **Continuous improvement and innovation** to ensure the programme is current and based on good practices.

Enforcement generally occurs when serious deficiencies in compliance are identified and may lead to administrative or criminal proceedings depending on the country's regulatory regime. It is important to align criminal and administrative law that apply to these cases. Enforcement should be consistent, fair and transparent.

Figure 6.1. Functioning of the main components of an inspection and enforcement function in the standard Plan-Do-Check-Act Management Model.

The OECD has developed guidance on this topic, such as the 2014 OECD Best Practice Principles for Regulatory Enforcement and Inspections[5] that discusses an overarching framework to support initiatives to improve regulatory enforcement through inspections, and the 2018 OECD Regulatory Enforcement and Inspections Toolkit[6] offers criteria for assessing the inspection and enforcement system.

[5] OECD (2014), *Regulatory Enforcement and Inspections*, OECD Best Practice Principles for Regulatory Policy, OECD Publishing. http://dx.doi.org/10.1787/9789264208117-en

[6] OECD (2018), *OECD Regulatory Enforcement and Inspections Toolkit*, OECD Publishing, Paris. https://doi.org/10.1787/9789264303959-en

7 Non-governmental standards

Government is not the only entity contributing to the regulation of specific operations and activities associated with chemical accident prevention, preparedness and response. But standards within the private sector are often non-binding unless specifically referred to within legislation or are only binding on the membership of a specific organisation or industry. However, the adoption and declaration of adherence to specific standards is often the basis for private contracts. These may then be enforced through independent audits or supply-chain audits carried out by a customer or a supplier to verify compliance.

International standards organizations

Two of the most established international standards organisations in this field are the International Organization for Standardization (ISO), and the International Electrotechnical Commission (IEC). ISO is composed of the national standards bodies (NSBs), one per member economy. The IEC is similarly composed of national committees, one per member country. In some cases, the national committee to the IEC of an economy may also be the ISO member from that country or economy. ISO and IEC are private international organizations that are not established by any international treaty. Their members may be non-governmental organizations or governmental agencies.

Both ISO and IEC have numerous standards which apply to chemical accidents prevention, preparedness and response. These cover many different aspects such as technical equipment, process control systems, and methods for risk assessment and management systems.

Regional standards organisations

Regional standards bodies also exist, such as the European Committee for Standardization (CEN), the European Committee for Electrotechnical Standardization (CENELEC), the European Telecommunications Standards Institute (ETSI), and the Institute for Reference Materials and Measurements (IRMM) in Europe, the Pacific Area Standards Congress (PASC), the Pan American Standards Commission (COPANT), the African Organisation for Standardisation (ARSO), the Arabic Industrial Development and Mining Organization (AIDMO). In the European Union, only standards created by CEN, CENELEC and ETSI are recognized as European standards (according to Regulation (EU) No 1025/2012), and member states are required to notify the European Commission and each other about all the draft technical regulations concerning information and communication technology (ICT) products and services before they are adopted in national law. These rules were laid down in Directive 98/34/EC with the goal of providing transparency and control regarding technical regulations.

National standards bodies

In general, each country or economy has a single recognized national standards body (NSB). A national standards body is likely the sole member from that economy in ISO; ISO currently has 169 members.

Many standards are adopted at international, regional and national level leading to a nomenclature indicating where the standard was adopted and the form of publication. There may be minor differences due to individual national criteria.

Independently of these bodies and organisations there are many other standard setting organisations, which are concerned with aspects of chemical accidents, such as:

- NFPA National Fire Protection Association
- ASTM International American Society for Testing and Materials
- ASME American Society of Mechanical Engineers
- IEEE Institute of Electrical and Electronics Engineers
- API American Petroleum Institute
- SCC Standards Council of Canada

Chemical Industry

The International Council of Chemical Associations (ICCA) has developed Responsible Care® as the global chemical industry's voluntary initiative to foster safe management of chemicals and continually improve the environmental, health, safety and security performance of processes, operations and products. Responsible Care® began in Canada in 1985, and today, is practiced in nearly 70 global economies. A fundamental component of Responsible Care® is the adoption of codes, guidance, policies or procedures around a set of core values and objectives, including those related to chemical accidents. Examples include published fact sheets on process safety management, workplace health and safety, and reducing chemical incidents during re-starts. By implementing a common management approach, national associations can connect the Responsible Care® principles to national and international practices, standards and sustainability principles. Reporting of Key Performance Indicators (KPIs) is a cornerstone of Responsible Care®. Associations around the world work collaboratively with their company members to collect and report data on industry performance[7].

Corporate social responsibility is another concept embraced by industry and can be defined as acknowledging a responsibility to the society that exists around it with respect to health, safety, security of people and the protection of the environment. It is a form of self-regulation that can be expressed in initiatives or strategies, depending on the company goals. For example, a brochure by CEFIC, the European Chemical Industry Council, provides information on social responsibility and highlights the social responsibility projects for various member companies.[8]

The adoption of non-governmental standards either voluntarily or within a contractual relationship can lead to more stringent requirements being placed on an operation than national government regulations would require. This is generally due to the specificity of the standards and the fact that government regulations tend to be more goal-oriented, with a requirement on the operator of hazardous installation to apply appropriate standards.

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[7] See, https://icca-chem.org/focus/responsible-care/

[8] CEFIC, Brochure, Sustainability of products What it's all about, see https://cefic.org/app/uploads/2019/01/Sutainability_of_products_What_its_all_about_BROCHURE_Sustainability.pdf

Corporate standards

Large corporations with an international presence may develop standards within their own operations to guarantee the same level of operation and safety across all their installations. These standards may eventually be adopted or adapted by other corporations or industries, leading to general improvement in safety.

Annex A. History of regulations related to chemical accidents

The regulation of chemical process safety has been addressed in a broad sense in several countries since the 1970s. However, the first regulations adopted to reduce the risks to the surrounding population apply to the manufacture of explosives, in this case, gunpowder.

In 1654, in Delft (Netherlands), a black powder store exploded demolishing a large part of the city and killing 1500 people. In 1807, an explosion of around 17 tons of gunpowder in the city of Leiden (Netherlands) killed 151 people, injured 2000 and damaged hundreds of houses. As a result of this explosion, an Imperial Decree was issued stating, among other things, that a license was needed to operate a facility. Three categories of facilities were distinguished: facilities that were too dangerous to be allowed inside a city, and for which the authorities would indicate a location outside the city; facilities that could be allowed inside a city if their safety could be demonstrated by the proprietor; and facilities that could always be allowed. In addition, it was decreed that objections from (future) neighbours of the facilities should be taken down in writing and addressed by the authorities[9].

An explosion in 1794 at the Grenelle (France) gunpowder factory of at least 30 tonnes of powder led to the death of more than a thousand people, extensive damage and large numbers of homeless[10]. The report compiled by Treilhard on behalf of the Committees of Public Health and Safety on the Grenelle gunpowder factory explosion stipulated that certain measures be implemented[11]:

- fabrication of powder in several locations (powder mill) and in locations far from all habitation, thus reducing quantities and thus the risk at the source;
- replacement of labourers by new, recently developed "mechanisms";
- improvement of the quality of the substance produced.

The industrial revolution in Britain at the end of the 18th century led to the development of chemical manufacturing industries. These produced alkali, soda, bleach and sulphuric acid for glass, soap, and bleaching of cotton etc. This, in turn, led to highly polluted atmospheres in the neighbourhood of these factories. As a result, the Alkali Act (1863) was passed in Great Britain regulating the emissions from these premises and further regulations followed[12.]

The industrial revolution also led to concerns for the safety of workers in the new industries and the need to protect them from exposure to hazards due to pressure vessels and steam, moving machinery, specific

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9 Ale, B.J.M., Tolerable or Acceptable: A Comparison of Risk Regulation in the United Kingdom and in the Netherlands (2005) Risk Analysis, Vol. 25, No. 2, 231-241

10 ARIA No. 5692, Explosion of the Grenelle gunpowder factory August 31, 1794, Paris https://www.aria.developpement-durable.gouv.fr/fiche_detaillee/5692_en/?lang=en

11 Rapport de Treilhard, au nom des comités de Salut public et de Sûreté générale, sur l'explosion de la poudrerie de Grenelle, lors de la séance du 15 fructidor an II (1er septembre 1794), https://www.persee.fr/doc/arcpa_0000-0000_1990_num_96_1_15253_t1_0174_0000_9

12 Interest Group Environmental Chemistry, 150th anniversary of the establishment of the Alkali Inspectorate, Peter Reed, Historical Group of the Royal Society of Chemistry, ECG Bulletin July 2014, https://www.envchemgroup.com/150th-anniversary-of-the-establishment-of-the-alkali-inspectorate.html

chemicals that were recognised as leading to occupational health impacts, dusts and other working conditions. This led to regulations such as the Factory Acts[13] [14] which were pieces of legislation passed throughout the 19th century and into the 20th century in the United Kingdom. In Germany, the Gewerbeordnung (1869)[15] regulated trade and industry including potential impacts on their surrounding areas. In the Netherlands, the Fabriekswet (1875)[16] and the Veiligheidswet (1895)[17] addressed similar issues.

In the second half of the 20th century, many countries began to establish comprehensive legislation to address worker health and safety. For example, in 1970, the United States passed the Occupational Safety and Health Act (OSHA)[18]. Japan introduced the Industrial Safety and Health Act (ISHL) in 1972[19], and in, 1974, the United Kingdom enacted the Health and Safety at Work etc. Act (HASWA)[20]. The UK HASWA Act came about after the introduction of a Bill into Parliament in 1970 following consultation on a comprehensive review of existing legislation starting in 1967. Debate surrounding this Bill led to the appointment of Lord Robens to chair a committee to review legislation on safety and health to determine whether changes are required in major legislation on the nature and extent of voluntary safety and health work, and to consider whether further steps are required to protect the public from hazards of industrial origin. The committee reported in 1972, which, in turn, led to the passing of the Health and Safety at Work etc. Act 1974 and the establishment of the Health and Safety Executive. Of note in the provisions of this Act, are Section 2 (General duties of employers to their employees) and Section 3 (General duties of employers and self-employed to persons other than their employees) that set out the duty of protection as far as is reasonably practicable. The HASWA was enacted 31st July 1974 and came into force on 1st January 1985.

While the HASWA was progressing through Parliament, an explosion occurred on Saturday, June 1st, 1974 at the Nypro Works in Flixborough (UK) that killed 28 and seriously injured 36 of the 72 people on site at the time. Damage to housing occurred at several kilometres. A Court of Inquiry was established on 27th June 1974 to investigate the causes of the accident and to identify lessons to be learned. A report

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13 The 1833 Factory Act, UK Parliament https://www.parliament.uk/about/living-heritage/transformingsociety/livinglearning/19thcentury/overview/factoryact/ (accessed November 2024)

14 Later factory legislation, UK Parliament, https://www.parliament.uk/about/living-heritage/transformingsociety/livinglearning/19thcentury/overview/laterfactoryleg/ (accessed November 2024)

15 Gewerbeordnung für das Deutsche Reich vom 21. Juni 1869, https://www.digitale-sammlungen.de/de/view/bsb11174892?page=5

16 Gorter, A., 1889. De Fabriekswet van 2 Juni 1875 en hare toepassing bij hooger beroep. Bijdrage tot de kennis der rechtspraak op nijverheidsgebied. 's-Gravenhage 1889, p. 75. Ex-bibliotheca Tweede Kamer (#22295).

17 De veiligheidswet: wet van 20 juli 1895 (staatsblad no. 137), houdende bepalingen tot beveiliging bij het verblijven in fabrieken en werkplaatsen, in werking getreden 1 Januari 1897 : met inleiding en aanteekeningen, ook in verband met de wijzigingen in de Arbeidswet en de Hinderwet, Hendrik Goeman Borgesius, Van Druten, 1897, https://books.google.fr/books/about/De_veiligheidswet.html?id=vQhWAAAAcAAJ&redir_esc=y

18 US OSHA, Final Rule on Process Safety Management of Highly Hazardous Chemicals; Explosives and Blasting Agents 1992, https://www.osha.gov/laws-regs/federalregister/1992-02-24

19 Japan Industrial Safety and Health Act Act No. 57 of 1972, https://www.cas.go.jp/jp/seisaku/hourei/data/isha.pdf

20 United Kingdom Health and Safety at Work etc Act 1974, https://www.hse.gov.uk/legislation/hswa.htm#:~:text=The%20Health%20and%20Safety%20at,and%20members%20of%20the%20public

was published in 1975[21]. Parallel to this investigation, the Advisory Committee on Major Hazards was established to look at the longer-term issues associated with hazardous process plants. The committee reported in 1976, 1979 and finally in 1984 when it was disbanded.

In the Netherlands, the Cobben Commission was initiated on August 18, 1975, to investigate the hazards in the south of Limburg. Shortly afterwards, on November 7, 1975, an explosion occurred at the naphtha cracker of the DSM ethylene plant in Beek, Limburg. Fourteen people were killed and 107 injured[22].

In 1976, changes in the wider awareness for chemical accidents occurred, when the release of the contents (6 tonnes) of a chemical reactor from the ICMESA chemical manufacturer, in the northern Italian town of Meda, spread over the neighbouring communities, including the town of Seveso. Initially, there was little information provided by the company, but people realised that all was not well relatively quickly. Within days, 3300 animals (poultry and rabbits) had died. Numerous people were affected with skin inflammation and chloracne and it was discovered that a significant quantity (estimated at 15 to 30 kg) of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) had been released contaminating an area of 18 square kilometres[23].

Less than two months later, a release of arsenic compounds from a petrochemical plant in Manfredonia (Italy) occurred. The Italian government appealed to the European Commission that there was a need for European regulation. On July 19, 1979, the European Commission adopted a proposal for a Directive on the major-accident hazards of certain industrial activities. However, it was a further three years and substantial amendments before the Council adopted a Directive, with the "Seveso Directive" enacted in 1982[24].

It was not until the Bhopal Disaster on December 3, 1984, that chemical accident prevention gained a global viewpoint. The disaster led to enormous number of fatalities (official figures 2250 immediate deaths, other estimates are over 8000). More than half a million injured victims have been recognised[25].

The European Seveso Directive was amended for the first time on March 19, 1987, following an initial proposal from the Commission in November 1985. Qualifying threshold values for specific toxic substances were reduced.

In 1985, the U.S. Environmental Protection Agency (US EPA), in response to the potential for catastrophic releases, initiated a programme to encourage community planning and preparation relative to serious hazardous materials releases (Ex. 2: 5). In 1986, Congress passed the framework for emergency planning efforts through Title III of the Superfund Amendments and Reauthorization Act (SARA), also known as the Emergency Planning and Community Right-to-Know Act (42 U.S.C. 11001 et seq.)[26]. SARA encourages and supports states and local communities in their efforts to address the problems of chemical releases. Under section 302 of SARA, 42 U.S.C. 11002, the US EPA was required to publish a list of extremely

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21 Health and Safety Executive, 'The Flixborough Disaster: Report of the Court of Inquiry', HMSO, ISBN 0113610750, 1975.

22 DSM hit by another big plant explosion, Chem. Eng. News 1975, 53, 46, 7–8, https://pubs.acs.org/doi/10.1021/cen-v053n046.p007b

23 ARIA No 5620, Seveso accident: release of dioxins into the atmosphere in a chemical plant, July 1972, ARIA database, https://www.aria.developpement-durable.gouv.fr/wp-content/files_mf/FD_5620_meda_Seveso_1976_ang.pdf

24 European Union, Council Directive 82/501/EEC of 24 June 1982 on the major-accident hazards of certain industrial activities, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A31982L0501

25 Loss Prevention Bulletin, Remembering Bhopal 40 years on, Issue 299, October 2024, https://www.icheme.org/media/27533/lpb299online.pdf

26 US EPA,1986, Emergency Planning and Community Right-to-Know Act, https://www.epa.gov/epcra/what-epcra (accessed November 2024)

hazardous substances with threshold planning quantities, which would trigger planning in states and local communities (52 FR 13378).

Following the enactment of this legislation, the United States subsequently authorised the Clean Air Amendment Act of 1990 (CAAA)[27]. This Act introduced Section 112(r) Prevention of accidental releases, which required the US EPA to develop regulations to prevent chemical accidental releases and to minimize the consequences of any such release of any substance listed.

The Act also included Section 304 Chemical Process Safety Management, in which the Secretary of Labor, in coordination with the Administrator of the US EPA was required to promulgate a chemical process safety standard to prevent accidental releases of chemicals, which could pose a threat to employees. The CAAA required that the standard include the development of a list of highly hazardous chemicals, which include toxic, flammable, highly reactive and explosive substances. The CAAA specified the minimum elements, which must be covered by the standard.

In addition to these requirements to regulate, the CAAA established the US Chemical Safety Board (CSB) with the remit to investigate accidents and make recommendations. While it took several years for regulations to come into force and for the CSB to take up its role, the CAAA is a significant step in chemical process safety.

The fire at the Sandoz pesticide warehouse in Schweizerhalle (Switzerland) and subsequent release of fire-fighting water into the river Rhine that led to the pollution of the Rhine from Basel throughout its length to the Netherlands led to further developments in the regulation of chemical accidents. In Europe, there was an amendment of the Seveso Directive[28]. At the international level, within the auspices of the UN Economic Commission for Europe (UNECE), work started on what was to become the UNECE Transboundary Industrial Accidents Convention (TEIA), which was adopted in 1992 and entered into force in April 2000[29].

Other international bodies have also adopted regulatory measures regarding the prevention of chemical accidents. The International Labour Organisation (ILO) adopted C174 - Prevention of Major Industrial Accidents Convention, 1993 (No. 174) and published the recommendation R181 - Prevention of Major Industrial Accidents Recommendation, 1993 (No. 181). This followed from earlier work in the ILO Code of Practice “Prevention of major industrial accidents” from 1991[30].

27 US EPA, Clean Air Act Amendment, 1990, https://www.epa.gov/clean-air-act-overview/1990-clean-air-act-amendment-summary (accessed 2024)

28 ARIA No 5187, The Rhine polluted by pesticides, 1986, ARIA database, https://www.aria.developpement-durable.gouv.fr/wp-content/files_mf/FD_5187_schwizerhalle_1986_ang.pdf

29 UNECE (2015), Convention on the Transboundary Effects of Industrial Accidents, https://unece.org/DAM/env/documents/2017/TEIA/Publication/ENG_ECE_CP_TEIA_33_final_Convention_publication_March_2017.pdf .

30 ILO (1993), Prevention of Major Industrial Accidents Convention, No. 174, International Labour Organization, https://normlex.ilo.org/dyn/nrmlx_en/f?p=NORMLEXPUB:55:0::NO::P55_TYPE%2CP55_LANG%2CP55_DOCUMENT%2CP55_NODE:CON%2Cen%2CC174%2C%2FDocument

ILO (1993), Prevention of Major Industrial Accidents Recommendation, No. 181, International Labour Organization, https://normlex.ilo.org/dyn/nrmlx_en/f?p=NORMLEXPUB:55:0:::55:P55_TYPE,P55_LANG,P55_DOCUMENT,P55_NODE:REC,en,R181,/Document

ILO (1991), Code of Practice: Major Industrial Accidents, International Labour Organization, https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40ed_protect/%40protrav/%40safework/documents/normativeinstrument/wcms_107829.pdf

Following the conclusions adopted by the OECD's Third High-Level Meeting of the Chemicals Group on 17-18 March 1987 regarding the prevention of, and response to, unintended releases of hazardous substances to the environment; the OECD adopted its first two legal instruments in the field of chemical accidents:

- Decision-Recommendation concerning Provision of Information to the Public and Public Participation in Decision-making Processes related to the Prevention of, and Response to, Accidents Involving Hazardous Substances [C(88)85-Final]
- Decision of the Council on the Exchange of Information concerning Accidents Capable of Causing Transfrontier Damage [C(88)84-Final]

With regard for the concluding statements of the OECD Conference on Accidents Involving Hazardous Substances held in 1988, the OECD adopted a third legal instrument:

- Recommendation on the Application of the Polluter-Pays Principle to Accidental Pollution [C(89)88-Final]

These three instruments have been updated and consolidated into a single instrument adopted in 2023 by the OECD Council, the Decision-Recommendation of the Council concerning Chemical Accident Prevention, Preparedness and Response [31].

Within the European Community (now European Union), further research and experience in implementation of chemical regulations in the European Community, including experience from major accidents such as the Piper Alpha disaster in the North Sea, prompted a decision to revise the Seveso Directive. In particular, the scope was newly defined, based around establishments (sites) rather than individual installations and the emphasis was placed on the hazardous properties of the substances which were stored or handled on site. An increased focus was placed on safety management systems, land-use planning and information to the public. This directive became known as the Seveso II Directive (Council Directive 96/82/EC)[32].

In 2008, the adoption of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) in 2002 and its implementation within the European Union (EU) and European Economic Area (EEA) through the Regulation on classification, labelling and packaging of substances and mixtures (CLP-Regulation) meant that the Seveso Directive was once again revised to take account of the new classification requirements. In addition, the requirements on inspection of establishments by public authorities and on information to the public were further strengthened. The UNECE TEIA Convention was amended in 2015 following the changes in the Seveso III Directive and the adoption of the GHS system of classification.

[31] OECD, Decision-Recommendation of the Council concerning Chemical Accident Prevention, Preparedness and Response, OECD/LEGAL/0490

[32] EU (2012), Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the Control of Major Accident Hazards Involving Dangerous Substances – Seveso-III-Directive, European Union, https://eurlex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32012L0018.

Benefits of Regulation for Chemical Accident Prevention, Preparedness and Response

Presenting the Case for Senior Policymakers and other Stakeholders

Series on Chemical Accidents

Countries around the world have been setting up legal frameworks to address the prevention, preparedness and response to chemical accidents and yet, chemical accidents with serious consequences continue to happen in OECD Member countries and worldwide. Even so, the consequences of policy inaction are still insufficiently understood by many decision-makers. Assessment of regulations can be considerably improved by better understanding the drivers of regulations and the benefits of these regulations. The purpose of this document is to provide background information to support the case for why regulations in this field are important and how effective regulations can be developed.