UNEP

A Flexible Framework for Addressing Chemical Accident Prevention and Preparedness

A Guidance Document

UNITED NATIONS ENVIRONMENT PROGRAMME

IOMC

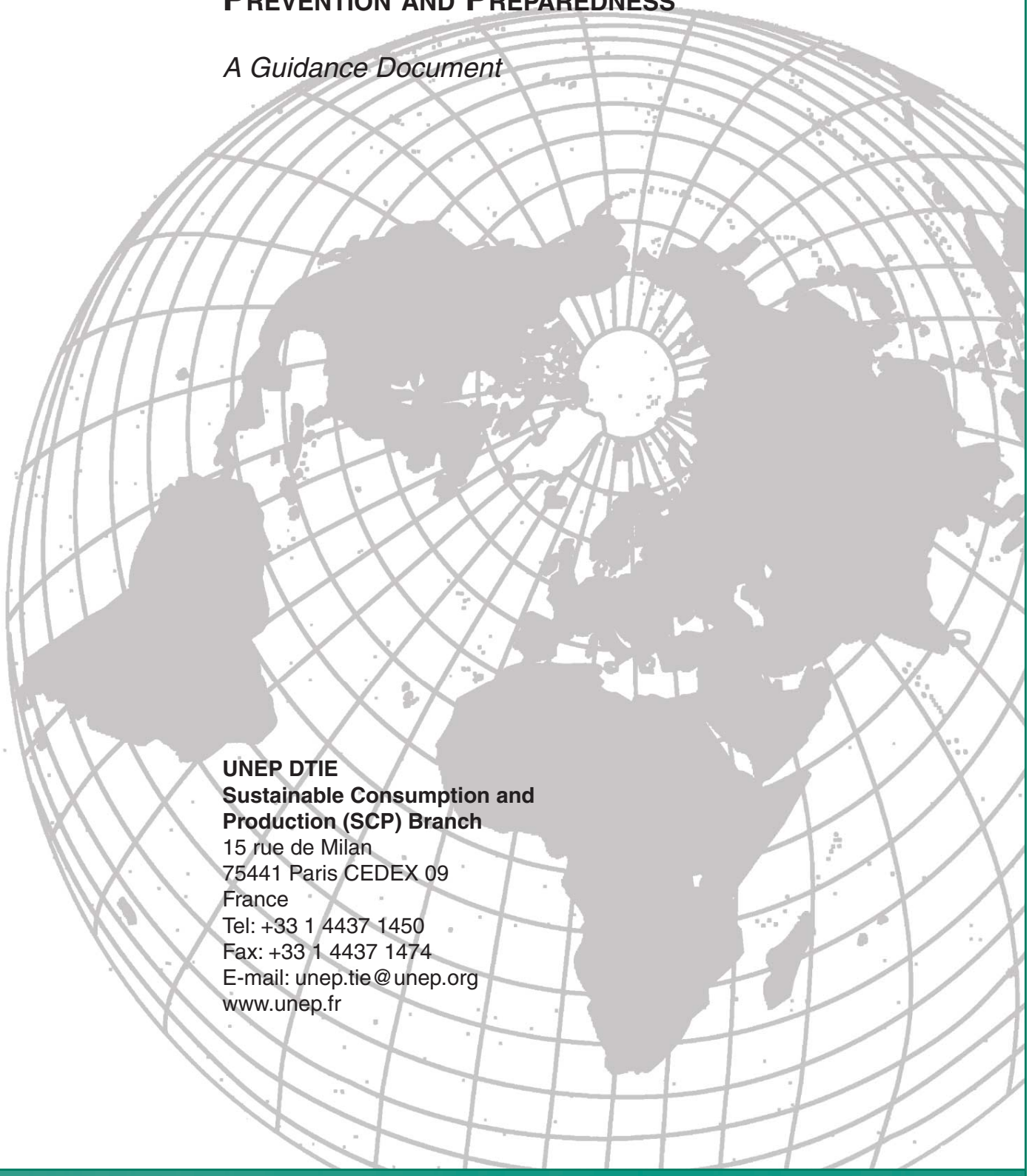
INTER-ORGANIZATION PROGRAMME FOR THE SOUND MANAGEMENT OF CHEMICALS

A cooperative agreement among FAO, ILO, UNEP, UNIDO, UNITAR, WHO and OECD

ISBN: 978-92-807-3094-4

A Flexible Framework for Addressing Chemical Accident Prevention and Preparedness

A Guidance Document



UNEP DTIE
Sustainable Consumption and Production (SCP) Branch
15 rue de Milan
75441 Paris CEDEX 09
France
Tel: +33 1 4437 1450
Fax: +33 1 4437 1474
E-mail: unep.tie@unep.org
www.unep.fr

This *Guidance* was developed by a group of international experts, under the auspices of the United Nations Environment Programme Division of Technology, Industry and Economics (UNEP DTIE), as part of its work pursuant to the Strategic Approach to International Chemicals Management (SAICM) adopted in February 2006.

The aim of SAICM is to "achieve by 2020, the use and production of chemicals in ways that lead to the minimisation of significant adverse effects on human health and the environment." One of the identified work areas of SAICM is "formulation of prevention and response measures to mitigate the environmental and health impacts of emergencies involving chemicals." For further information on SAICM, see: www.saicm.org.

UNEP DTIE encourages decision-makers in government, local authorities, and industry to develop and implement policies, strategies, and practices that are cleaner and safer, make efficient use of natural resources, ensure environmentally sound management of chemicals, reduce pollution and risks for humans and the environment, enable implementation of conventions and international agreements, and incorporate environmental costs.

The UNEP DTIE strategy is to influence informed decision-making through partnerships with other international organisations, governmental authorities, business and industry, and nongovernmental organisations; support implementation of conventions; and build capacity in developing countries.

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, UNEP, UNIDO, UNITAR, WHO, and OECD. The World Bank and UNDP are observers. 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.

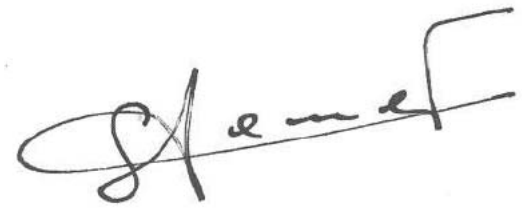
FOREWORD

Growth in the industrial sector has been a valuable element of economic development strategies in many developing countries worldwide. However, many of the chemicals used in industrial operations present a risk of chemical accidents that can cause extensive harm to people, the environment, and local or even national economies. We at UNEP recognise the need for additional capacity building in the area of chemicals management, particularly in fast-growing economies that are experiencing rapid industrialisation and need support in addressing industrial chemical accident prevention and preparedness.

To address the risk of chemical accidents, it is crucial for governments to develop chemical accident prevention and preparedness programmes to reduce the likelihood of accidents and limit the consequences of accidents that do occur. This document was designed to assist governments that want to develop, review, or strengthen their chemical accident prevention and preparedness programmes. While there are many aspects of chemical accident prevention that will be similar regardless of the location, it is important to recognise that every country is different in terms of the chemical risks present, the resources available to address these risks, and the political, cultural, and economic situation of the country. For this reason, this document has been designed to be flexible enough to be tailored to the circumstances of a given country.

The advantages of reducing the likelihood and consequences of chemical accidents – including better protection of human health, the environment, and economic resources – are well known. However, we at UNEP believe that the benefits of developing a national chemical accident prevention and preparedness programme go beyond merely reducing the number of industrial accidents in a country. National chemical accident programmes are an important aspect of sustainable development and a method by which governments can respond to international requirements to foster responsible industrial systems and address the challenges of a green economy. Robust and integrated chemicals management policies are a vital component of a commitment to a more sustainable future.

By using this document, we hope that governments will improve their ability to proactively manage the chemical risks in their countries and encourage industries to engage in chemical accident prevention and preparedness activities, resulting in an increased capacity for sustainable development.



Sylvie Lemmet, Director
Division of Technology, Industry and Economics
United Nations Environment Programme

ACKNOWLEDGEMENTS

This publication (called the "*Guidance*") is the result of an international initiative launched by the United Nations Environment Programme (UNEP) in 2007 to improve chemical safety, particularly in fast-growing economies that are experiencing rapid industrialisation and need support to address chemical accident prevention and preparedness. The *Guidance* builds upon more than 30 years of experience in addressing chemical accident prevention and takes into account international agreements in this area, key national/regional laws/regulations, and other international guidance materials.

To develop the *Guidance*, UNEP established an Expert Working Group with selected experts in chemical safety and industrial accident prevention and preparedness.

The Group included representatives of relevant UN agencies, including the International Labour Organization (ILO), the United Nations Economic Commission for Europe (UNECE), the United Nations Industrial Development Organization (UNIDO), the United Nations Institute for Training and Research (UNITAR), the World Health Organization (WHO), and the UNEP/Office for the Coordination of Humanitarian Affairs (OCHA) Joint Environment Unit, known as the Joint UNEP/OCHA Environment Unit (JEU). There were also representatives from other inter-governmental organisations, including the European Commission (EC) and the Organisation for Economic Co-operation and Development (OECD), as well as non-governmental organisations such as the Asian Disaster Preparedness Centre (ADPC). Other participants included the International Council of Chemical Associations (ICCA) and the *Centro de Tecnologia Mineral/Programa Iberoamericano de Ciencia y Tecnologia para el Desarrollo* (CETEM/CYTED). Select government officials from national organisations, including the Netherlands, the Swedish Civil Contingencies Agency (MSB), Thailand, the United States Environmental Protection Agency (US EPA), and independent experts were also represented in the Expert Working Group.

The *Guidance* is being published under the framework of the Inter-Organisation Programme for the Sound Management of Chemicals (IOMC). The Participating Organisations of the IOMC include the Food and Agriculture Organization (FAO), ILO, UNEP, UNIDO, UNITAR, WHO, and the OECD.

The Expert Working Group met five times between November 2007 and April 2010 to prepare and finalise the *Guidance.*

Members of the Group included:

- Ms. Sandra Averous (UNEP)
- Mr. Rainar All (MSB)
- Ms. Helen Arromdee (Thailand)
- Mr. Tobias Biermann (EC)
- Mr. Ralph Brieskorn (The Netherlands)
- Dr. Chalermchai Chaikittiporn (Thailand)
- Ms. Sophie Dunkerley (UNEP)
- Mr. Luciano Fabbri (EC - Joint Research Centre)
- Ms. Carina Fredström (MSB)
- Ms. Virginia Fusé (UNECE)
- Dr. Kersten Gutschmidt (WHO)
- Mr. Mark Hailwood (Independent Expert)
- Mr. John Haines (UNITAR)
- Mr. Leo Heileman (UNEP)
- Mr. Arab Hoballah (UNEP)
- Ms. Marie-Chantal Huet (OECD)
- Ms. Kim Jennings (US EPA)
- Ms. Kathy Jones (US EPA)
- Mr. Marcelo Kós Silveira dos Campos (ICCA)
- Mr. Seiji Machida (ILO)
- Mr. Kaj Madsen (UNEP)
- Mr. Tomas Marques (UNEP)
- Mr. Desta Mebratu (UNEP)
- Mr. Alain Pierrat (ICCA)
- Mr. Loy Rego (ADPC)
- Ms. Vanda Santos (JEU)
- Ms. Fran Schulberg (Independent Consultant)
- Ms. Julie Shortridge (UNEP)
- Mr. Rene Van Berkel (UNIDO)
- Mr. Roberto Villas Boas (CETEM/CYTED)
- Ms. Maureen Wood (EC - Joint Research Centre)
- Mr. Lukasz Wyroswski (UNECE)
- Ms. Ruth Zugman Do Coutto (UNEP)

Ms. Ruth Zugman Do Coutto and Mr. Kaj Madsen were responsible for managing this project with the support of Mr. Tomas Marques. The main writer and editor of the *Guidance* was Ms. Fran Schulberg. Mr. Mark Hailwood, Ms. Maureen Wood, and Ms. Kim Jennings provided substantial technical input.

The layout and design of this *Guidance* was made possible by a contribution by the US EPA, led by Ms. Kim Jennings and Ms. Kathy Jones of US EPA, with the work being done by Ms. Katie Garvey and Mr. Chris Herman of SRA International, Inc.

A Framework for Addressing Chemical Accident Prevention and Preparedness

A Guidance Document Prepared by UNEP

TABLE OF CONTENTS

SUPPLEMENTAL GUIDANCE

ANNEXES

TABLES

TEXT BOXES

EXECUTIVE SUMMARY

It is important for every country to consider whether it should initiate an effort to develop, review, and/or improve their chemical accidents programme. UNEP created this *Guidance* to support such efforts.

Almost every country experiences chemical accidents each year. These occur at small facilities such as pesticide warehouses and large installations such as refineries, at public facilities including water treatment plants using chlorine or private manufacturing facilities for the chemical, pharmaceutical, and consumer products industries; in urban settings and industrial parks or in rural areas where there might be mining operations or refrigeration facilities. Some of these accidents are well-known: Seveso, Bhopal, Schweizerhalle, Baia Mare, etc.[1]

Most accidents are not well-publicised and may not be known beyond their borders. However, accidents often have serious, even devastating consequences: workers are hurt or killed; the public is exposed to chemicals or fires resulting in immediate injury or long-term health impacts, rivers and underground water sources are polluted impacting drinking water and industries that rely on the water including fishing and agriculture; the facilities and nearby developments suffer significant damage sometimes resulting in closure of companies or temporarily shutting down operations; and other adverse effects to health, the environment, and property. Political leaders are often blamed when an accident occurs because of a failure to recognise the risks and to take appropriate action to protect their citizens and communities.

Effective action to address the issues of accident prevention and preparedness requires political commitment and coordinated efforts of many different agencies and organisations that have a role to play including government bodies responsible for environmental protection, occupational health and safety, public health, civil defence, emergency response, and industrial development as well as industry, workers, community groups, and other nongovernmental organisations.

An effort to develop a chemical accidents programme should be coordinated with, and be part of, an overall effort to address chemical safety.[2]

Based on the interest of countries to try to reduce chemical accidents and mitigate impacts of accidents that do occur, UNEP brought together a group of experts to prepare this *Guidance*. The members of this Expert Working Group have extensive experience implementing national and international programmes for chemical accident prevention and preparedness.

This *Guidance* focuses on prevention and preparedness at fixed installations and is designed to help countries establish a programme that is appropriate for their particular circumstances, including the level and nature of risks, the available resources, and the legal and cultural context. Thus, it is titled a "Flexible Framework" reflecting the fact that it is meant to be used by any country, irrespective of location, size, or level of industrialisation, with the expectation that each country would design its own programme. Furthermore, it is recognised that many countries will start with a small, limited programme and expand as experience and resources allow.

Specifically, this *Guidance* sets out a process to help countries, for example:

- get the necessary commitments and establish coordinating mechanisms;
- identify and prioritise the hazards and risks in their country;
- determine what authority and resources exist and where there are gaps;
- identify which aspects of a chemical accidents programme are appropriate to their circumstances (giving guidance on how to implement each of these aspects); and
- implement the programme.

This *Guidance* provides examples of how existing laws and international agreements address various aspects of a chemical accidents programme. It also contains information on other materials and resources that are available to support a country's effort.

This *Guidance* recognises that it can be difficult to get the attention for this issue until a major accident occurs and that there are many issues competing for limited resources. But the potential consequences of inaction are very severe, and the benefits for implementing a programme are clear. These benefits include not only the damage avoided from preventing or mitigating accidents but also from the indirect financial savings due, for example, from improved efficiency and lower production costs, improvements in general environmental performance, and increased goodwill and community support.

---

[1] Additional information is provided in Table I (Overview of Some Notable Accidents) on page 14.
[2] This is consistent with the aim of the international initiative entitled SAICM – the Strategic Approach to International Chemicals Management (see page II).

Chapter A: INTRODUCTION

A1: Purpose of this Flexible Framework *Guidance*

The purpose of this *Guidance* is to support any government that wants to develop, improve, or review their programme for chemical accident prevention and preparedness related to hazardous installations.

All countries should review their chemical accidents programme in order to identify opportunities to prevent or reduce the likelihood of chemical accidents and to improve preparedness so as to minimise any impacts on people, communities, the environment, and property should an accident occur.

This includes large and small countries, whether they have significant risks of chemical accidents (*e.g.*, a country with large chemical facilities) or have more limited risks (*e.g.*, a country with no chemical manufacturing or processing industry but which has several warehouses of pesticides, water treatment facilities using chlorine, and/or a port that receives bulk chemicals in transit to other countries).

Chemical accidents – such as a fire in a pesticide warehouse, leaks from a container being loaded off a ship, an explosion at a refinery, a spill from a vandalised pipeline, a break in mine tailings storage, a vapour cloud resulting from a process problem during maintenance, or a dust explosion in a grain silo – can cause deaths and serious injuries to workers and the local population as well as significant long-term health effects. Chemical accidents can harm livestock, crops, and water supplies and cause considerable environmental damage. They can also result in major economic losses for the enterprise involved and for the entire community.

This *Guidance* focuses only on issues related to chemical accident prevention and preparedness. Thus, it does not deal with the broader issues of occupational health and safety, nor does it address chronic, ongoing pollution which may occur at the same facilities which are targeted in a chemical accidents programme.

The *Guidance* is specifically designed to provide practical guidance, which can be used in many different countries. Thus, this document contains a lot of information. Its size and detail does not imply that a country needs to address all the issues described herein.

Rather, each country can use this *Guidance* to develop a chemical accidents programme that is appropriate for their particular risks and is consistent with their local culture, legal system, and available resources.

This *Guidance* builds on more than 30 years experience by countries and international organisations and, specifically, is based on several international agreements as well as the legislation from the European Union (the "Seveso II Directive") and the US. Additional information is provided in Text Box 1 (The Flexible Framework in an International Context) on page 5.

All countries face constraints with limited staff, funds, equipment, and other resources. This *Guidance* helps countries to understand how they can identify risks, assess priorities, and address these in order to make the most efficient use of the resources that are available.

This *Guidance* seeks to encourage countries to do the best that they can in their circumstances by focusing on the most important issues, taking advantage of the information and assistance that is available, being open to asking for support and engaging stakeholders within the country (from, *e.g.*, industry, workers, the medical field, academia, non-governmental organisations) in order to benefit from their ideas and experience. Furthermore, this *Guidance* recognises that implementing a chemical accidents programme is a process, which can start with small steps and grow and improve over time.

To help countries use this *Guidance*, UNEP is developing related training materials and case studies.

Furthermore, there are other international sources of assistance and information to support a country's efforts to address chemical accident prevention and preparedness. Some of these are described in this *Guidance* and in Annex VI (Selected Bibliography).

Why a "Flexible Framework"?

This *Guidance* is entitled "Flexible Framework" because it can be used by any country to develop a chemical accidents programme that is appropriate for its local circumstances. It does NOT provide a legal text that can be taken as a whole and implemented. Rather, this *Guidance* is designed as a tool to help governments identify their needs and priorities, and then create and implement appropriate instruments and mechanisms.

Each country should choose relevant parts of this *Guidance* and adapt them in light of factors such as the size and nature of its chemical risks, its legal and administrative structures, local culture, local language(s), and available resources. It is expected that most countries will implement their chemical accidents programme in stages, as priorities, resources, and experience allow.

Specifically, this *Guidance* provides a framework by:

- describing the steps that are needed for developing, implementing, and reviewing the laws, regulations, policies, guidance, or other instruments which would make up an effective chemical accidents programme;
- setting out the possible elements of such instruments; and
- providing resource materials related to how these elements may be implemented, based on international initiatives and the experience of countries that have had chemical accident programmes in place for a number of years.

To help the reader, set out below are the definitions of several terms. These definitions have been prepared for purposes of this document (and should not be considered agreed definitions among international organisations or countries).

Definitions have been derived from the OECD *Guiding Principles for Chemical Accident Prevention, Preparedness and Response* (2nd ed., 2003), unless otherwise noted. Different documents referenced in this *Guidance* might use somewhat different definitions of these terms.

chemical accident: any unplanned event involving hazardous substance(s) – such as a spill, release, fire, or explosion – that causes, or is liable to cause, harm to health, the environment, or property. This excludes any long-term events (such as chronic pollution).

hazard: inherent property of a substance, agent, source of energy, or situation having the potential of causing undesirable consequences.

hazardous installation: a fixed industrial plant/site at which hazardous substance(s) are produced, processed, handled, stored, used, or disposed of in such a form and quantity that there is a risk of an accident involving hazardous substance(s) that could cause serious harm to human health or damage to the environment, including property.

hazardous substance: an element, compound, mixture, or preparation which, by virtue of its chemical, physical, or (eco) toxicological properties, constitutes a hazard. Hazardous substances also include substances not normally considered hazardous but which, under specific circumstances (*e.g.*, fire, runaway reactions) react with other substances or operating conditions (*e.g.*, temperature, pressure) to generate hazardous substances.

chemical accidents programme: in this document is meant to encompass the collection of laws, regulations, policies, guidance, and other instruments developed by a country to address the various aspects of chemical accident prevention and preparedness. These may be administered by different authorities at national, regional, and/or local levels. It should be recognised that although chemical accident response and recovery are not addressed in this *Guidance*, they are important aspects of a complete chemical accidents programme (Note: this definition was developed just for this *Guidance*).

These definitions were excerpted from Annex I (Definition of Terms). Annex II (Acronyms) contains a list of acronyms.

Text Box 1

THE FLEXIBLE FRAMEWORK IN AN INTERNATIONAL CONTEXT

This Flexible Framework *Guidance* reflects more than 30 years of experience in addressing chemical accident prevention and preparedness. Specifically, this *Guidance* builds on several international agreements as well as a number of other international initiatives. It also takes into account the approaches used by the member countries of the European Union (as reflected in the "Seveso II Directive") and other countries such as the US.

The relevant international agreements include:

- **International Labour Organisation (ILO) Convention 174 Concerning the Prevention of Major Industrial Accidents** (adopted 1993), which addresses both prevention and the limitation of consequences of major accidents involving hazardous substances. It applies to major hazards installations, which are defined by the presence of quantities of hazardous substances that exceed a specific threshold. Ratifying states are allowed a large measure of discretion in applying the Convention (and, therefore, this Flexible Framework can aid in implementation of the ILO Convention). The full text is available at: http://www.ilo.org/ilolex/english/convdisp1.htm. A number of related ILO Conventions, Recommendations, and guidance documents are available on the ILO website. Some of these are listed in Annex VI (Selected Bibliography).

- **UN Economic Commission for Europe (UNECE) Convention on the Transboundary Effects of Industrial Accidents** (signed in 1992), which is designed to protect human health and the environment from industrial accidents. The Convention promotes active cooperation between countries before, during, and after an industrial accident has occurred. The focus of the Convention is on industrial accidents with transboundary consequences. The full text is available at: http://www.unece.org/env/teia/about.html. Guidance related to this Convention is available on the UNECE website.

With respect to national approaches, this *Guidance* focuses on experience from Europe and the US:

- In the European Union, the key legislation is the Seveso II Directive. The Seveso accident in 1976 prompted the adoption of legislation aimed at the prevention and control of such accidents. In 1982, the first EU Directive 82/501/EEC – so-called Seveso Directive – was adopted. On 9 December 1996, the Seveso Directive was replaced by Council Directive 96/82/EC, so-called Seveso II Directive. This directive was extended by the Directive 2003/105/EC. The Seveso II Directive applies to some thousands of industrial establishments where dangerous substances are present in quantities exceeding the thresholds in the Directive. The full text of the Directive is available at: http://ec.europa.eu/environment/seveso/index.htm.

  In order to assist countries with the application of the Seveso II Directive, the European Commission, mainly through its Major Accident Hazards Bureau (MAHB) in the Joint Research Centre, has elaborated several guidance documents and databases. These are available at: http://mahb.jrc.ec.europa.eu.

- In the US, Congress passed a series of laws intended to minimise the likelihood and consequences of catastrophic chemical accidents. The first major law was the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) which focused on community emergency planning. The Clean Air Act (CAA) Amendments of 1990 (section 112(r)) called for EPA to develop regulations and guidance to prevent chemical accidents at facilities using hazardous substances that could affect the public and environment off-site. The Risk Management Plan Rule (RMP Rule), written to implement Section 112(r), requires companies of all sizes that use certain flammable and toxic substances to develop a Risk Management Program. Details about the laws and RMP rule, along with a number of guidance documents, can be found at: www.epa.gov/emergencies.

This *Guidance* was designed to complement a number of other international initiatives related to chemical accident prevention and preparedness. In addition to ILO and the UNECE, a number of other UN bodies and inter-governmental organisations have prepared materials that provide valuable advice and resources for countries that want to create, or improve, their chemical accident programmes. These organisations include:

- UNEP and, in particular, its Awareness and Preparedness for Emergencies at Local Level (APELL) Programme;[3]
- the World Health Organisation;[4]
- the Joint UNEP/OCHA Environment Unit; and
- the Organisation for Economic Co-operation and Development.

There is also valuable information from non-governmental initiatives and from individual countries. More information is provided in Annex V (Other International Initiatives) on page 163 and Annex VI (Selected Bibliography) on page 170 for the web addresses of a number of these organisations.

A2: Why Establish a Chemical Accidents Programme

Such programmes help to prevent accidents and limit any impacts of accidents that do occur, thereby avoiding or minimising harm to people, and damage to the environment and property.

There are many examples of chemical accidents – unintended spills, releases, fires, explosions – that have resulted in serious injuries, environmental catastrophes, economic hardship, and other significant harm. While some of these are well-known and even identified internationally by just a place-name (Bhopal, Seveso, Baia Mare), there have been many more that are not widely publicised. Furthermore, significant accidents continue to occur throughout the world in large and small countries and in large and small facilities.

See Tables I, II, and III at the end of this Chapter for information on well-known accidents, on potentially hazardous activities, and on examples of loss of containment, respectively.

Saving Lives, Protecting Health and the Environment

Chemical accidents can have devastating impacts on human health and the environment. For example, they can cause direct, immediate harm to workers and others in the vicinity who are exposed to the harmful chemicals, or who are injured by an explosion or fire. Acute exposures to chemicals can also cause longer-term health consequences including chronic diseases and cancer. People can also suffer harm from indirect contact through their diet as the result of contaminated drinking water, agricultural products, fish, livestock, and other food items because of polluted air, surface water, and soil.

The release of hazardous substances into air, water, and soil can have serious environmental consequences, killing animals and vegetation, poisoning water supplies used for drinking, fishing, and irrigation, and rendering soil unfit for agriculture.

Economic Impacts

It is difficult to calculate the costs and benefits of implementing a chemical accidents programme. However, there is convincing evidence that accident prevention and preparedness is a wise investment, with the costs involved in improving safety being less than the cost of accidents.[5]

In addition to the potential impact on human health, accidents can cause significant economic harm, both to the enterprise as well as to the community. The costs associated with response, clean-up and recovery, including health response such as medical treatment, can be quite significant.

It may be obvious that the enterprise where the accident occurred may suffer significant economic losses (from, *e.g.*, property damage, loss of jobs, having to stop operations for an extended period, or even bankruptcy). What is not as obvious are the costs to other industries in the vicinity of the accident. For example, an accident may pollute local waterways increasing the costs of water used for drinking and agriculture and causing significant damage to the fishing industry. In addition, suppliers and customers of the enterprise will be impacted.

Chemical accident programmes provide indirect financial benefits, in addition to the direct savings from accident avoidance. For example, such programmes often lead to improved efficiency and lower production costs, as well as to improvements in the general health, safety, and environmental performance of enterprises. Safe operations also protect the good will and reputation of industry and public authorities, as well as foster improved relationships with members of the local communities.

---

[3]While the Flexible Framework is designed to support national efforts to improve chemical accident prevention and preparedness, the focus of APELL is on the communities where hazardous installations are located, creating a process to build partnerships among industries, local authorities, and the public. As a local process for hazard communication and coordination, on the ground APELL is a shared framework 'owned' by the local community and its rescue services. Consisting of a modular, flexible methodological tool to prepare for accidents and, failing this, to minimise their impacts, the APELL process allows decision-makers and technical personnel to increase community awareness and to prepare coordinated response plans.

[4]Chemical events of international public health concern are subject to the revised International Health Regulations 2005 (IHR 2005) which came into force on 15 June 2007. The purpose and scope of the new IHR are to prevent, protect against, control, and provide a public health response to the international spread of disease. The scope of obligations is not limited to any specific disease or manner of transmission, but to conditions, irrespective of source, that could present significant harm to human beings. Events that fall under IHR (2005), therefore, are not restricted to communicable diseases with epidemic and pandemic potential, but also include emergencies due to contamination with toxins, chemicals, or radioactive material due to industrial leaks. Consequently, states are required to develop a core capacity to manage chemical events that may constitute a public health emergency of international concern (PHEIC).

[5]See, *e.g.*, CCPS, *The Business Case for Process Safety* (2nd edition) (2006).

Political Benefits

There are significant political benefits to having an effective chemical accidents programme. At the international level, such programmes can help countries comply with international agreements, or recommendations, related to reducing chemical risks including the ILO and UNECE Conventions and the WHO International Health Regulations 2005. This Flexible Framework should also help countries participate effectively in international cooperative efforts under the auspices of UNEP, ILO, WHO, UNECE, OECD, and other international organisations.

At the national level, a chemical accidents programme can help improve cooperation and coordination among the many agencies and bodies with relevant responsibilities, including those with mandates related to environmental protection, occupational health and safety, public health, civil defence, emergency response (fire, police, medical, Hazardous Materials [HAZMAT]), land-use planning, industrial development, mining, and agriculture.

At the local level, creating an effective chemical accidents programme has significant political implications. The programme provides a platform for improving communication and trust between local leaders, the public, and other stakeholders. Furthermore, communities typically blame local leaders for accidents if there has not been adequate warning or appropriate response.

A3: Scope of this *Guidance*

This document provides guidance to governments that want to address risks associated with "hazardous installations." Specifically, this *Guidance* focuses on:

- **prevention of chemical accidents, *i.e.*, avoiding incidents and lessening impacts of any incidents, as well as learning from experience to control hazards and reduce risks;[6] and**
- **preparedness for chemical accidents, *i.e.*, being ready for accidents, and trained to act, prior to the onset of an incident. This involves putting into place the systems and resources needed for appropriate emergency response in the event of an accident, including diagnosis and treatment of injured persons and communication with the public.**

What are Chemical Accidents?

For purposes of this *Guidance*, a *chemical accident* is defined as any unplanned event involving hazardous substances that causes or is liable to cause harm to health, the environment, or property. This excludes any long-term or on-going events (such as chronic pollution). The types of accidents addressed by this *Guidance* include any sudden loss of containment, explosion, or fire involving chemicals at fixed installations.

Chemical accidents are generally caused by unintended technological failures, negligence, or human errors (or a combination of these). But they can also be triggered by natural disasters or from deliberate action (such as sabotage, vandalism, or theft).

Table I (Overview of Some Notable Accidents) on page 14 describes a number of well-known chemical accidents such as: Flixborough (UK 1974); Seveso (Italy 1976); Bhopal (India 1984); Mexico City (Mexico 1984); Basel (Switzerland 1986); Pasadena (US 1989); Baia Mare (Romania 2000); Enschede (Netherlands 2000); Toulouse (France 2001); Texas City (US 2005); Jilin, Songhua River (China 2005); and Buncefield (UK 2005).

As noted, there have been, and continue to be, many chemical accidents that are not publicised occurring throughout the world, originating in both large and small facilities.

What are Hazardous Installations?

Hazardous installations are defined as fixed industrial plants/sites at which hazardous substance(s) are produced, processed, handled, stored, used, or disposed of in such a form and quantity that there is a risk of an accident involving hazardous substance(s) that could cause serious harm to human health or damage to the environment, including property.

---

[6]For purposes of this *Guidance*, the terms hazard and risk are defined as follows:

- *hazard* is an inherent property of a substance, agent, source of energy, or situation having the potential of causing undesirable consequences; and
- *risk* is the combination of a consequence and the probability of its occurrence.

These definitions are based on the OECD *Guiding Principles for Chemical Accident Prevention, Preparedness and Response* (2nd ed., 2003).

The focus of this *Guidance* is on fixed installations such as factories, storage facilities, and transport interfaces.[7]

When considering whether a particular type of installation should be subject to controls as part of a chemical accidents programme, the primary criteria should be the level of risk posed by the installation. The level of risk is dependent not on the size of the operation, but rather on:

- the specific hazardous substances at the installation;
- the quantity of such substances;
- the nature of the processes and safety systems involved; and
- the extent and nature of the population, environment, and property that could be impacted in the event of an accident.

Thus, chemical accident programmes should not be limited to larger enterprises. Small and medium-sized enterprises that could pose significant chemical accident risks should also be addressed.

Furthermore, hazardous installations are not limited to the chemical, pesticides, and petrochemical industries. There are numerous industries, and many types of facilities, that use, store, or create hazardous chemicals and, therefore, pose a risk of a significant chemical accident.

Based on the history of past accidents, these could include: bulk and specialty chemicals manufacturers; producers and packagers of pesticides; fertiliser plants; pharmaceutical facilities; plastic and rubber manufacturers; power generators; liquefied petroleum gas (LPG) and liquefied natural gas (LNG) storage, power supply and distribution facilities; oil and chemical pipelines; transport interfaces; mining-associated chemical processing facilities; warehouses storing chemicals or pesticides in bulk or as packaged goods; pyrotechnical/ explosive manufacturers or warehousing; refrigeration facilities; manufacturers of consumer products such as electronics or painted materials; metals refining and processing; ceramics producers; waste disposal facilities; water treatment plants; and facilities that use or store chlorine or propane.

It is also important to remember that chemical accidents are not limited to privately-owned installations. Public facilities, or installations that are managed by government organisations, might also pose significant risks (*e.g.*, water treatment or waste disposal facilities, storage of chlorine or other hazardous chemicals, power generators, marshalling yards, public utilities).

Transport of Hazardous Substances: The focus of this *Guidance* is on fixed installations and, therefore, this *Guidance* does not address issues that relate solely to transport accidents such as the road worthiness of vehicles, loading and unloading hazardous substances (*e.g.*, not overloading, stability of load), capacity of drivers, or suitability of routes. However, many of the aspects of the *Guidance* apply to such transport accidents, in particular with respect to preparedness planning. Furthermore, there is a correlation between transport safety and the safety of installations.

Even though not specifically addressed herein, transport of hazardous goods by road/trucks, rail, ships, or airplanes is an important issue and should be addressed in a country's overall programme to address chemical risks.[8]

---

[7]Transport interfaces are defined as: fixed (identified) areas where hazardous substances (dangerous goods) are transferred from one transport mode to another (*e.g.*, road to rail, or ship to pipeline); transferred within one transport mode from one piece of equipment to another (*e.g.*, from one truck to another); transferred from a transport mode to a fixed installation or from the installation to a transport mode; or stored temporarily during transfer between transport modes or equipment. Thus, transport interfaces involve transfer facilities, temporary holding or keeping of hazardous substances during cargo transfer (*e.g.*, warehousing), and handling of damaged vehicles or spilled goods. Examples include: railroad marshalling yards; port areas; receiving/loading docks at hazardous installations; terminals for roads and for intermodal transport between road and rail, airports; and transfer facilities at fixed installations.

[8]The United Nations has developed mechanisms to help reduce the risk of transport accidents involving dangerous goods and promote consistency between regulatory systems in different countries and between different modes of transport. The UN mechanisms include harmonized regulations concerning hazard classification criteria and hazard communication tools (GHS) and harmonized regulations concerning the conditions for all modes of transport (TDG). In addition, the UN has developed regulations for land, sea, and air transport. These include:

- ADR for international road transport (primarily in Europe);
- RID for international rail transport (primarily in Europe);
- IMDG code for maritime transport; and
- ICAO-TI (IATA-DGR) for air transport.

For additional guidance on addressing transport of hazardous goods, see Annex VI (Selected Bibliography) on page 170.

While many countries address issues related to the transport of hazardous goods in separate legislation from the issue of safety of hazardous installations,[9] it is possible to have a single law or policy which deals with both aspects.

For example, the Swiss Ordinance on "Protection against Major Accidents" (MAO 1991) applies to both fixed facilities where specified hazardous substances above set threshold quantities are located (see Annex III (Lists of Chemicals of Concern) on page 143 which shows the Swiss concept to define threshold quantities), as well as to transport routes used for the shipping of dangerous goods by railway lines, roads, and the Rhine river.[10]

In either case (whether there is one system for fixed installation and transport, or whether they are addressed in different legal instruments with different lead authorities), it is important for relevant officials to coordinate their efforts to achieve overall safety objectives and avoid having a decision to increase safety in one sector having the result of increasing risks in another. For example, a decision to reduce inventories of hazardous substances at a chemical processing plant might result in a safer installation but increase the risk of transport accidents because of the need for more frequent deliveries.

Pipelines: Petrochemicals and other hazardous substances are often transported by pipelines which have some of the characteristics of fixed installations but also raise special concerns with respect to chemical accident prevention and preparedness. Supplemental Guidance (SG) 5 (Guidance on Pipelines) on page 132 contains some further information on improving safety of pipelines.

What is Not Included in this *Guidance*?

This *Guidance* focuses on **chemical accident prevention and preparedness at fixed installations**. Thus, the following items are **not** addressed:

- *General issues related to occupational health and safety* including, for example, accidents that do not involve hazardous substances (such as employees being injured by a fall or electric shock).
- *Chronic pollution* (regular or on-going emissions) or disposal of hazardous wastes.
- *Emergency response* – while a comprehensive approach to chemical accidents would involve the full safety continuum (*i.e.*, prevention, preparedness, response, and recovery) this *Guidance* focuses on prevention and preparedness while recognising that attention to prevention and preparedness leads to improved response.[11] One reason for not including a chapter on response in this *Guidance* is that, in most countries, the subject of emergency response is addressed in a different regulatory context than prevention and preparedness. Response is often a shared responsibility between local, national, and regional bodies (fire, police, medical, HAZMAT).[12] Furthermore, there are other international organisations which have programmes that address emergency response.
- *Recovery from chemical accidents* including long-term clean-up and restoration.
- *Transport of hazardous substances (dangerous goods)*, as described above.
- *Nuclear Installations* or plants processing radioactive materials (except to the extent that they also involve chemical hazards).[13]
- *Site security*, *i.e.*, accidents that result from security breaches (*e.g.*, terrorism, vandalism). While much of what is included in this *Guidance* applies to any chemical accident, irrespective of the cause, there are special considerations related to security concerns.

[9]The key documents referenced in this *Guidance*, including the ILO and UNECE Conventions, the Seveso Directive, and the US laws focus on fixed installations.

[10]The Swiss Ordinance also applies to facilities where dangerous natural or genetically modified micro-organisms are contained.

[11]Preparedness sets the stage for response (and must not be just a paper exercise). It is important that preparedness planning takes into account a realistic assessment of response resources and is consistent with the response system in place in the country or region. Everyone who may be involved in emergency response should participate in the planning process. And everyone with a role in accident prevention, preparedness, and response should be coordinating their efforts and working towards a shared vision of the existing risks, the priorities for addressing these risks, and the practical implications of any actions. Furthermore, one major aspect of preparedness planning is the testing of plans and learning from the experience gained in response to accidents and incidents.

[12]References to guidance related to emergency response are included in Annex VI (Selected Bibliography) on page 170.

[13]A number of publications concerning nuclear safety are available from the International Atomic Energy Agency. See: http://www.iaea.org/Publications/Standards/index.html.

A4: Who Should Use this *Guidance*

This *Guidance* is addressed primarily to government authorities that are seeking to develop or improve their chemical accident programmes. It can also be used to review existing programmes in order to make improvements, identify gaps, or facilitate implementation of international agreements and standards.

Thus, this *Guidance* should be helpful to countries with little or no activities or systems in place to address chemical accident prevention and preparedness, as well as countries that have some competencies in this area and want to determine whether improvements can be made.

This *Guidance* describes how governments can establish laws, regulations, policies, programmes, and other instruments that identify actions that should be taken by industry, authorities, and others to reduce the likelihood of chemical accidents and to improve preparedness for accidents that might occur.

This *Guidance* recognises that the risks posed by hazardous installations are generally not created by government authorities, and that enterprises have the primary responsibility for the safety of their hazardous installations and for establishing appropriate accident prevention policies, programmes, and procedures.[14]

Government authorities should, however, take steps to identify the location of hazardous installations and establish systems for ensuring that industries adequately address chemical safety and emergency preparedness. This *Guidance* also recognises that government authorities (and other stakeholders) have important roles and responsibilities in order to protect communities, the environment, and property. Furthermore, this *Guidance* emphasises the importance of cooperation and communication between industry, authorities, and others.

Developing and implementing laws, regulations, policies, and other instruments does not affect the responsibility of owners/operators of hazardous installations to operate safely.

Generally, the government's roles and responsibilities are shared among several different authorities (*e.g.*, ministries, agencies) as well as authorities at different levels (national, regional, and local). These could include authorities responsible for: environmental protection, occupational health and safety, public health, civil defence, emergency response (fire, police, medical, HAZMAT), land-use planning, and industrial development.

Laws, regulations, policies, and other instruments are most often adopted on a national level (with identified roles for local and regional authorities). However, in some countries local/regional authorities (*e.g.*, states, provinces) may take the lead for some or all of these issues addressed in this *Guidance*.

It is not possible to recommend a particular approach, since the allocation of roles and responsibilities for the different aspects of prevention and preparedness will depend on each country's legal, administrative, and cultural context.

One thing that is true for all countries is the importance of having all the relevant authorities coordinate their activities and cooperate to maximise efficiency of available resources as well as improve the overall effectiveness of the chemical accidents programme.

It is also important for government authorities to cooperate with non-governmental stakeholders including industry, workers, non-governmental organisations, and communities at risk in the event of an accident.

Coordination and cooperation can be difficult given resource and time constraints as well as possible overlapping responsibilities and political pressures. Nevertheless, effective coordination is key to a successful chemical accidents programme.

[14]See Text Box 2 (Roles of Stakeholders) on page 11 for an overview of the Roles of Stakeholders (industry, government authorities, and the public) with respect to accident prevention and preparedness.

Text Box 2

ROLES OF STAKEHOLDERS

One important aspect of any effective programme for chemical accident prevention and preparedness is the involvement of all the relevant stakeholders. Generally, industry has primary responsibility for the safety of their hazardous installations. Government authorities are responsible for setting policies and objectives, establishing and implementing laws and programmes to help protect human health, the environment, and property, and motivating all stakeholders to act safely. Other stakeholders also have roles to play and, in particular, the communities where the installations are located.

The following is a summary of "best practices" related to the roles and responsibilities of the different stakeholders (*i.e.*, goals to be achieved over time) from the OECD *Guiding Principles on Chemical Accident Prevention, Preparedness and Response* (2nd ed., 2003).

Role of All Stakeholders

- Make chemical risk reduction and accident prevention, as well as effective emergency preparedness and response, priorities in order to protect health, the environment, and property.
- Communicate and cooperate with other stakeholders on all aspects of accident prevention, preparedness, and response.

Role of Industry (including management and workers)

Management

- Know the hazards and risks at installations where there are hazardous substances.
- Promote a "safety culture" that is known and accepted throughout the enterprise.
- Establish safety management systems and monitor/review their implementation.
- Utilise "inherently safer technology" principles in designing and operating hazardous installations.
- Be especially diligent in managing change.
- Prepare for any accidents that might occur.
- Assist others to carry out their respective roles and responsibilities.
- Seek continuous improvement.

Workers

- Act in accordance with the enterprise's safety culture, safety procedures, and training.
- Make every effort to be informed and to provide information and feedback to management.
- Be proactive in helping to inform and educate your community.

Role of Government Authorities

- Seek to develop, enforce, and continuously improve regulations, policies, and practices.
- Provide leadership to motivate all stakeholders to fulfil their roles and responsibilities.
- Monitor the industry to help ensure that risks are properly addressed.
- Help ensure that there is effective communication and cooperation among stakeholders.
- Promote inter-agency coordination.
- Know the risks within your sphere of responsibility and plan appropriately.
- Mitigate the effects of accidents through appropriate response measures.
- Establish appropriate and coherent land-use planning policies and arrangements.

Role of Other Stakeholders (*e.g.*, communities/public)

- Be aware of the risks in your community and know what to do in the event of an accident.
- Participate in decision-making relating to hazardous installations.
- Cooperate with local authorities and industry in emergency planning and response.

A5: How to Use this *Guidance*

This *Guidance*:

- **describes a process for developing or reviewing a chemical accidents programme (see Chapter B);**
- **sets out key elements of a chemical accidents programme that can be adapted by any country (see Chapter C);**
- **provides additional resource materials (see Supplemental Guidance); and**
- **includes reference materials (see Annexes).**

Contents of Chapter B (How to Develop or Improve a Chemical Accidents Preparedness and Prevention Programme)

The process set out in Chapter B includes a number of steps with a view towards:

- getting the necessary commitments and identifying relevant agencies that should be involved;
- establishing appropriate consultative and coordination mechanisms;
- identifying local initiatives related to chemical safety;
- describing the existing legal context;
- assessing risks and available resources to help determine priorities;
- reviewing possible elements of a chemical accidents programme, as described in Chapter C, to determine which are relevant in light of the priorities;
- developing the content of the programme which could include laws, regulations, policies, and other instruments;
- establishing the necessary administrative structures, tools, and procedures;
- determining resource requirements;
- implementing a country-specific chemical accidents programme; and
- reviewing and revising the programme periodically to make sure that it is working as intended, and updating legal instruments and policies in light of experience and changing priorities.

These steps are described in five phases: Initial Phase; Assessment Phase; Development Phase; Implementation Phase; and Review and Revision Phase.

These phases are illustrated in a flow chart set out in Table IV (Stages in the Development and Implementation of a Chemical Accidents Programme) on page 30. A summary of the goals and activities for each of these phases is included in Annex IV (Consolidated List of Activities for Developing a Chemical Accidents Programme) on page 160.

The five phases are not necessarily linear; some parts of the process are iterative and will need to be repeated, and some steps are continuing rather than something that can be completed at a certain point. For example, it is important to engage all relevant agencies, and non-governmental stakeholders, through consultative and coordination mechanisms, and to continuously maintain such cooperation.

Implementation is emphasised in this *Guidance*. Having laws and policies in place, no matter how well-crafted, may be meaningless without sufficient implementation including enforcement. Therefore, it is critical that care be given to the systems and procedures for implementation and that appropriate resources be allocated.

Contents of Chapter C (Elements of a Chemical Accidents Programme)

Chapter C describes the elements of most chemical accident programmes. This Chapter is based on international agreements and the experience of a number of countries that have long-standing chemical accident programmes.

It is recommended that countries using this *Guidance* review the elements described in Chapter C, with a view to deciding which are relevant to their situation based on their current priorities.

Each element listed in Chapter C contains the following information:

- the goal of the element;
- why the element is important;
- how the element could be implemented; and
- possible pitfalls in implementation.

In addition, there are references to related sections in the ILO and UNECE Conventions, as well as the Seveso II Directive and US laws/regulations.

Chapter C is not intended to provide text that can be directly copied; rather, countries should review the list of possible elements to provide a starting point, and then adapt chosen elements taking into account their priorities as well as the availability of resources and the cultural/legal context.

In reviewing the possible elements of a chemical accidents programme, countries should keep in mind that they can begin with a limited chemical accidents programme, in light of the staff and other resources that may be available and the nature of the risks. This can be done, for example, by defining the scope of the programme narrowly to include only the highest priority facilities, by adopting only those elements that would be most effective given the resources that are available, and/or by establishing tiers of requirements for different types of facilities. The programme can then be expanded over time as resources and experience allow.

The following Tables provide some insights on the types of facilities and industries that might pose a risk of chemical accidents:[15]

Table I: Overview of Some Notable Accidents

Table II: Activities of Concern and their Typical Hazards

Table III: Loss of Containment

Table III has three parts:

- *Table IIIa* describes "precursors" or the types of events that might lead to loss of containment of hazardous substances.
- *Table IIIb* describes the types of loss of primary containment.
- *Table IIIc* describes the types of consequences of loss of containment.

These Tables provide examples and are not meant to provide a complete list of all possible activities that could create a risk of a chemical accident. Each country will need to consider which installations raise concerns in its area.

[15]These tables were created by Mr. Mark Hailwood for the purposes of this *Guidance*.

TABLE I:
Overview of Some Notable Accidents

This Table provides a few examples of chemical accidents that have occurred through 2009, in chronological order.

The focus of this Table is on accidents that have occurred in fixed installations, but it also includes several accidents involving transport of hazardous substances. While this *Guidance* does not address transport issues in detail, a comprehensive approach to chemical accidents should address both fixed installations and transport. It is important to note that many transport accidents involving hazardous substances are caused by the same problems as ordinary traffic accidents (*e.g.,* the state of the vehicles, roads, drivers) but have more serious consequences because of the nature of the goods being carried by road, rail, ship, or airplane.

The majority of accidents on this list involve very big accidents in developed countries in large measure because information is more readily available about such accidents. This is not reflective of the nature and size of accidents which occur each year. There are many smaller accidents which, while they may not make international headlines, still result in significant health, environmental, and economic costs. Chemical accidents occur everywhere, including developing countries and countries where there are no significant chemical or petrochemical industries.

Date	Place	Description	Casualties / Consequences
1 June 1974	Flixborough, United Kingdom	Inadequate design coupled with poor management of change led to a release of ca. 30 tonnes of cyclohexane at a chemical facility, resulting in a vapour cloud explosion which destroyed the facility and caused damage up to several km away.	• 28 killed • 89 injured
10 July 1976	Seveso, Italy	Loss of control of an exothermic chemical reaction led to the loss of the contents of the reactor via the bursting disc and the pressure relief system at a small chemical manufacturer. A cloud of toxic and corrosive chemicals formed, containing phenols, sodium hydroxide, and ca. 2 kg of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) "Seveso Dioxin." Among the causes were the use of an inherently more dangerous reaction route to produce the trichlorophenol (TCP) than competing companies and dangerous operating practices which allowed the production shift to leave the reactor with insufficient cooling at the end of the Saturday morning shift. Lack of management responsibility and poor communication by the company management and the local authorities once the accident took place meant that measures to prevent exposure of the population and to decontaminate the area were extremely slow to be activated.	• Large number of cases of Chloracne due to TCDD contamination • ca. 410 cases of chemical burns (probably caustic) • Evacuation of over 5,700 people from the area immediately affected by the toxic plume • Widespread contamination of the surrounding countryside • Large number of lifestock killed as a precautionary measure
11 July 1978	Los Afaques, San Carlos de la Rapita, Spain	A road tanker carrying 23 tonnes of highly flammable liquid propylene left the road and ran into a camping site. The leaking tanker formed a cloud of gaseous propylene that partially entered the camp-site and also drifted on the wind towards a disco to the north-east. The white cloud attracted the attention of camp-site patrons, who approached the cloud with curiosity as it continued to spread. As the cloud began to permeate the crowded disco,	• 217 killed (including the driver) • 200 severely burned

Table I: Overview of Some Notable Accidents *(continued)*

Date	Place	Description	Casualties / Consequences
11 July 1978	Los Afaques, San Carlos de la Rapita, Spain	(*continued*) it reached an ignition source and immediately flashed back into the tanker, causing a fire that nearly instantaneously ruptured the weakened tank and ignited the full load of gas in a massive BLEVE. The causes have been attributed to overloading of the road tanker coupled with the failure of the tank and possibly also a road traffic accident such as brake failure.	
10 November 1979	Mississauga, Ontario, Canada	A 106-car freight train carrying explosive and toxic chemicals from Windsor, Ontario was derailed, resulting in the largest peacetime evacuation in North America up until the New Orleans evacuation of 2005. The accident was caused as, on the 33rd car in the middle of the train's load, heat began to build up in an improperly-lubricated journal bearing on one of the wheels, resulting in the condition known among train workers as a hot box. Residents living next to the tracks reported smoke and sparks coming from the car, and those who were close to Mississauga thought the train was on fire. The friction eventually burned through the axle and bearing, and as the train was passing the Burnhamthorpe Road level crossing, one axle and pair of wheels fell completely off. The derailment ruptured several tankers containing hazardous chemicals, including chlorine. The ruptured chlorine tank presented a risk of a toxic gas cloud, requiring massive evacuation of the town's residents. Mississauga was practically a ghost town until the contamination had been cleared, the danger neutralised, and residents were allowed to return to their homes. The city was finally reopened in the evening of 16 November. The chlorine tank was emptied on 19 November.	• 200,000 evacuated
19 November 1984	Mexico City, Mexico	A 200 mm pipe between a storage cylinder and sphere ruptured, releasing LPG. The release continued for some 5 to 10 minutes resulting in a large gas cloud which ignited, causing an explosion and many ground fires. These ground fires led to a series of BLEVEs in the LPG terminal. The outstanding cause of escalation was the ineffective gas detection system and, as a result, lack of emergency isolation. The high death toll occurred because of the proximity of the plant to residential areas. The total destruction of the facility occurred because there was a failure of the overall system of protection, including layout, emergency isolation, and water spray systems. The terminal's fire water system	• 650 killed • 6,400 injured

Table I: Overview of Some Notable Accidents *(continued)*

Date	Place	Description	Casualties / Consequences
19 November 1984	Mexico City, Mexico	*(continued)* was disabled in the initial blast. The plant had no gas detection system and, therefore, when the emergency isolation was initiated it was probably too late.	
3 December 1984	Bhopal, India	A cloud of methyl isocyanate was released at a pesticide plant after water entered a storage tank, resulting in the deadliest chemical disaster in history. The addition of water to the tank caused a runaway chemical reaction, resulting in a rapid rise in pressure and temperature. This resulted in the formation of poisonous gases that escaped from the plant into the surrounding areas and drifted eight km over the city of Bhopal. The plant was located in a crowded working-class neighborhood, and there was no warning for people surrounding the facility as the plant emergency sirens had been switched off. The gas release resulted in the death of many people living in informal settlements near the installation who were blinded and suffocated by the chemicals. The storage of large amounts of toxic intermediate (an inherently unsafe process design), lack of effective safety measures and controls, poor site management, and close proximity of the local population have all been identified as major contributors to this accident and its devastating consequences.	• > 3,000 killed • 170,000 injured
1 November 1986	Schweizerhalle, Basel	A fire broke out in a warehouse storing large quantities of agrochemicals. Attempts to extinguish the fire with foam were ineffective and water was used in large quantities. The inability to contain the fire water on site meant that 10,000 m^3 of contaminated water with 30 tonnes of chemicals including ca. 150 kg of mercury compounds entered the River Rhine.	• Major disruption to the drinking water supply along the Rhine • Widespread ecological damage. The pollution travelled over 500 km
23 October 1989	Pasadena, Texas, United States	A chemical release occurred at the polyethylene plant of a chemical complex. A flammable vapour cloud formed which subsequently ignited, resulting in a massive vapour cloud explosion. Following this initial explosion there were a series of further explosions and fires. Failures of a number of technical and organisational aspects were the causes of this accident including: inadequate preparation of the installation for the maintenance work being carried out (permit to work, isolation); inadequate training and supervision; no gas detection system for the flammable gases; insufficient fire-fighting system which was also partially out of service or susceptible to fire damage itself.	• 23 killed • 130 to 300 injured

Table I: Overview of Some Notable Accidents *(continued)*

Date	Place	Description	Casualties / Consequences
3 December 1990	Chavanay - Loire, France	A train with 22 rail-tankers passing through the Rhone valley derailed when crossing the village. Nine 80 m^3 tankers filled with unleaded petrol spilt over, caught fire, and exploded. The fire spread to the residences near the railway line and to the sewers of the city. The accident area was 1 km long and 400 m wide. Out of the 720 m^3 of petrol in the 9 rail tankers, a large portion was consumed by the fire but 250 to 300 m^3 seeped into the soil and polluted 2 ha of the land. The power supply was cut off and road traffic brought to a halt. 180 fire-fighters used autonomous means (fire pumps, etc.) to fight the flames and prevent them from spreading to other parts of the town. An administrative enquiry report suggested that the accident may have occurred due to the passage of the train at an excessively high speed on a distorted railway track. The defect appeared due to the weakening of the railway track seating following torrential rains.	• 1 injured • 8 dwellings, 2 garages, and 30 cars were destroyed • 34 people were evacuated and re-housed • Rail transport was stopped for a week • 2 ha of land polluted • Agricultural wells situated downstream were closed and potable water pumping operations were reduced • Consumption of fruit and vegetables was banned within a perimeter of 12.5 ha
20 August 1997	Blaye, France	An explosion within a concrete grain silo complex led to the collapse of the silo structure. The employees who were killed died as the concrete structure and the grain within the silo collapsed upon the administration and technical buildings at the base of the silos. The cause of the explosion was most likely the ignition of an explosive dust/air mixture. The poor site layout meant that a large number of people were unnecessarily exposed to the risks from the silo. Effective dust collection, spark suppression, and fire monitoring systems could have prevented this accident.	• 11 killed • 1 injured
25 September 1998	Longford, Australia	The fracture of a heat exchanger released a cloud of hydrocarbon (ca. 10 tonnes) which dispersed and ignited at a distance of 170 m. This burnt back as a deflagration to a jet fire which then burnt for 2 days before it could be extinguished. The Royal Commission which investigated the accident found that among the causes were: poor design made isolation of hazardous materials difficult; inadequate training of personnel in normal operating procedures; excessive alarm and warning signals meant that workers were insensitive to hazardous situations; poor communication; lack of HAZOP of the heat exchanger meant that the risks were not recognised; and the company's safety culture was not suited to protecting workers and preventing process accidents.	• 2 killed • 8 injured • Break down of the gas supply in the State of Victoria for 20 days

Table I: Overview of Some Notable Accidents *(continued)*

Date	Place	Description	Casualties / Consequences
18 October 1998	Jesse, Nigeria	Blast from a leaking pipeline which had been vandalised. Over 1,000 people had gathered to collect fuel to sell on the black market.	• > 700 killed • > 100 injured
16 May 1999	Pakistan	A gasoline tanker carrying gasoline swerved to avoid cyclist and overturned. Gasoline was spilt over a large area near shops. Villagers were collecting spilt gasoline when it burst into flames, killing all nearby. A cigarette or burning match is thought to be responsible for igniting the fire.	• > 60 killed • > 150 injured
30 January 2000	Baia Mare, Romania	The collapse of a dam around a tailings pond of a precious metals recovery facility led to the release of ca. 100,000 m^3 of liquid and ca. 50 to 100 tonnes of cyanide as well as copper and other heavy metals into the local river which led to the pollution of the Somes, Tisza, and Danube rivers. The spill was initiated by heavy rain and melting snows which led to the collapse. There was no emergency plan in place and the risks of rain or melt water were not considered beforehand.	• Interruption of water supplies along the river network • Pollution of ca. 2,000 km of river basin
13 May 2000	Enschede, Netherlands	A stock of ca. 100 tonnes of explosives was detonated by a smaller fire. This led to a massive explosion and fireball which destroyed and damaged property in a wide area surrounding the site. Poor control of storage, as well as lack of control related to the siting of the installation, were major contributors to the accident.	• 21 killed • > 900 injured
21 September 2001	Toulouse, France	An explosion in an ammonium nitrate and fertiliser factory destroyed the facility and caused widespread damage in the surrounding area. Problems with land-use planning contributed to the extent of the damage and the number of injuries.	• 29 killed • ca. 2,500 injured
28 June 2004	Macdona, Texas, United States	Two trains collided, resulting in the derailment of 4 locomotives and 35 railcars. A filled 90 tonne chlorine railcar was breached releasing 60 tonnes of chlorine. In addition about 78,000 gallons of urea fertiliser as well as diesel fuel from the locomotives was spilt. The collision was blamed on crew fatigue.	• 3 killed • 43 injured (including 6 responders)
30 July 2004	Ghislenghien, Belgium	The high pressure gas pipeline from Zeebrugge-Blaregnies (80 bar operating pressure, 1,000 mm diameter) failed, resulting in a massive explosion and fire. The failure occurred at the Ghislenghien industrial park, near Ath, next to the facility of a diamond-cutting company, which was under construction. A gas leak was reported to fire-fighters at 08:30, local time, and the explosion occurred at 09:00. Many of the victims were fire-fighters and police, who were responding to the gas leak.	• 24 killed • 132 injured • Crater > 400 m diameter • Damage > €100 million

Table I: Overview of Some Notable Accidents *(continued)*

Date	Place	Description	Casualties / Consequences
30 July 2004	Ghislenghien, Belgium	*(continued)* The investigation of the explosion showed that the pipeline had been damaged in several places. There are strong indications that a soil compacter used by the construction company of the neighbouring facility damaged the pipeline, gouging deep grooves in the metal wall. When the police and fire-fighters arrived in the area to investigate the gas leak, there were difficulties in identifying the potential source and the operator of the pipeline.	
6 January 2005	Graniteville, South Carolina, United States	At roughly 2:40 am Eastern Standard Time, 2 trains collided in Graniteville. One train was parked on a siding. The other train, which was transporting chlorine gas, sodium hydroxide, and cresol, was diverted by an improperly lined rail-road switch onto the siding, where it collided with the parked train. The collision derailed both locomotives and 17 freight cars. One tank car loaded with chlorine ruptured, releasing at least 90 tonnes of the gas.	• 9 killed • 250 injured (treated for chlorine exposure) • 5,400 residents within a mile of the crash site were forced to evacuate for nearly 2 weeks while HAZMAT teams and clean-up crews decontaminated the area
23 March 2005	Texas City, Texas, United States	A major explosion occurred in an isomerisation unit of the refinery. This was caused by the overfilling of the raffinate splitter with liquid, overheating of the liquid, and release of hydrocarbon through the blowdown drum and stack. The ignition of this vapour cloud led to extensive damage to the facility and the casualties, many of whom were in temporary buildings located in a neighbouring installation. Numerous failings in equipment, risk management, staff management, working culture at the site, maintenance and inspection, and general health and safety assessments were identified as problems in the investigations of the incident.	• 15 killed • 170 injured
13 November 2005	Jilin, China	An explosion at a petrochemical plant resulted in the contamination of the Songhua River with an estimated 100 tonnes of benzene, aniline, and nitrobenzene. The plume of pollutants reached a length of over 150 km and moved very slowly along the frozen river.	• 6 killed • ca. 70 injured • 10,000 evacuated • Disruption of drinking water supply along the Songhua River • Transboundary pollution into the Russian Federation
11 December 2005	Buncefield, United Kingdom	The massive overfilling of a petroleum storage tank by pipeline at a fuel storage depot led to several explosions and a fire which engulfed 22 storage tanks. Inadequate control of the filling and tank gauging as well as an ineffective overfill protection system were the main causes of this incident. The close	• Substantial damage to property within a radius of 400 m • Windows were damaged several km away

Table I: Overview of Some Notable Accidents *(continued)*

Date	Place	Description	Casualties / Consequences
11 December 2005	Buncefield, United Kingdom	*(continued)* proximity of neighbouring office buildings and also residential property meant that there was substantial damage. There was no loss of life and relatively few injuries due to the fact that the incident took place early on a Sunday morning.	• Disruption to the fuel distribution network, particularly the distribution of aviation fuel to Heathrow airport
23 April 2007	Mongolia (200 km north of Ulan Bator)	An accident occurred at an informal operation to process gold ore using mercury and sodium cyanide. The processing of gold ore using mercury started in 2006 and a large quantity of waste containing mercury had accumulated. The processing of this waste by sodium cyanide to extract remaining gold began in February 2007. The related wastewater containing cyanide and mercury was subsequently poured directly to the waste treatment plant. That plant, located in the outskirts of the village, flowed over and created a pond with an estimated surface area of approximately 560 m^2. As a result, the drinking water well and water supplying system were polluted. In addition, the ground of the village was contaminated by mercury since the waste was not covered and spread by the wind.	• > 200 injuries • > 44,000 m^2 of soil contaminated with mercury and sodium cyanide • Ground water and drinking water supplies contaminated • Contaminated wastewater treatment plant
29 June 2009	Viareggio, Italy	5 of 14 rail tank wagons carrying LPG derailed close to the railway station of Viareggio before midnight. LPG leaked from the first wagon, igniting and exploding. Several further explosions were reported. The quick action of the station master to halt passenger trains outside of the station prevented further casualties. The cause of the derailment is attributed to a broken axle of the front LPG tank wagon.	• 32 killed • 26 injured • Several houses destroyed

Sources of Information for this Table

- Health and Safety Executive (HSE), Safety report assessment guidance (Technical aspects), Case Studies http://www.hse.gov.uk/comah/sragtech/casestudyind.htm
- Lees, F.P., 'Loss Prevention in the Process Industries – Hazard Identification, Assessment and Control', Volume 3, Appendix 1, Butterworth Heinemann, ISBN 0 7506 1547 8, 1996.
- UNEP (2006) The Songhua River Spill China, December 2005 – Field Mission Report
- Murray, V., Goodfellow, F. (2002) Mass casualty incidents – towards guidance for public health management, Public Health 116, 2-14 http://www.spoedeisendehulp.org/site/sites/default/files/masscasualtiechemicalincidents.pdf
- French Ministry of Environment – DPPR / SEI / BARPI – IMPEL http://www.aria.developpement-durable.gouv.fr/
- Wikipedia: http://en.wikipedia.org

TABLE II:
Activities of Concern and their Typical Hazards

The following Table lists typical industrial or commercial activities which utilise hazardous substances and, therefore, may create a risk of chemical accidents with adverse effects on people, the environment, and/or property. The nature and extent of the risk is dependent on a number of factors including the specific hazardous substances, the quantity of the substances, the type of processes involved, the safety measures in place, etc.

This is not an exclusive list; there are other activities that pose a risk of a chemical accident and these activities may have additional hazards associated other than those listed.

Activity	Typical Hazards (examples)
Processing of inorganic and organic chemicals with chemical reactions	• reactions involving hazardous chemicals (*e.g.*, toxic, flammable, explosive, hazardous to the environment) • reactions involving high temperature and/or pressure • reactions which release large amounts of energy (exothermic)
Blending, mixing, formulation, or repackaging of chemicals (*e.g.*, pesticides, pharmaceuticals, paints, lacquers, varnishes, etc.)	• processes involving powders which may lead to explosive dust/air mixtures • processes involving solvents with flammable or explosive characteristics • processes involving chemicals and products which are hazardous to the environment
Distillation, refining, or processing of petroleum or petroleum products	• processes involving highly flammable substances • processes involving high temperature and pressure • processes involving pyrophoric (spontaneously ignitable) compounds • processes involving toxic chemicals (*e.g.*, hydrogen fluoride, hydrogen sulphide)
Disposal or treatment of liquid or solid wastes by incineration or chemical reaction	• processes involving hazardous substances, often mixtures of substances, often the properties are not precisely defined • mixing of wastes which can lead to the production of hazardous substances
Production, storage or bottling of energy gases (*e.g.*, LPG, LNG, compressed natural gas [CNG])	• gases are highly flammable and build explosive atmospheres with air • storage installations contain large quantities of gas and may be located relatively near to residential areas, particularly when direct supply of heating or cooking fuel is involved
Production, storage, or bottling of technical gases with hazardous properties (*e.g.*, flammable, toxic, oxidising, explosive)	• storage installations contain large quantities of hazardous substances • transfer operations have the potential for release of hazardous substances
Cooling or refrigeration using hazardous substances (*e.g.*, ammonia)	• the potential release of hazardous substances under pressure may pose a substantial risk to a large number of people
Storage of hazardous substances in warehouses (*e.g.*, pesticides, pharmaceuticals, etc.)	• warehousing large quantities of substances may present a hazard to people and the environment should there be a fire or other event leading to a release • storage of incompatible products in close proximity
Surface treatment of metals using hazardous substances	• activities may include surface hardening using cyanides, pickling, or electroplating
Electric power generation using fossil fuels	• liquid fuels pose a potential fire risk due to their flammability and are potentially hazardous to the environment • De-NOx installations for treating exhaust gases which involve using ammonia gas or ammonia in solution are hazard sources
Bulk storage of hazardous liquids in tanks	• potential loss of containment may pose a risk to the environment • potential loss of containment of flammable liquids poses a fire risk

Table II: Activities of Concern and their Typical Hazards *(continued)*

Activity	Typical Hazards (examples)
Transport interfaces (*e.g.*, marshalling yards, lorry parks, container terminals, and airports where chemicals are loaded or unloaded, or where they are transferred from one vehicle to another)	• impact of vehicles or loading/unloading machinery, cranes, etc. with containers or tanks may cause them to rupture, releasing large quantities of hazardous substances • containers or tanks may have become damaged in transit and, therefore, already pose a chemical accident hazard on arrival • at terminals, chemicals may be unloaded by pipeline. Care needs to be taken that moving vehicles (e.g., moving rail car, release of ship from jetty, etc.) do not cause a release of hazardous materials • at sea or inland river terminals and ports, any release of chemical has a potential for causing an environmental impact to the marine and river eco-systems
Transport of hazardous substances	• accidents, such as the collision of the vehicle on which the chemicals are loaded, may lead to the release of these chemicals. If more than one substance is being transported and these substances are incompatible, then there is the potential for a hazardous chemical reaction in addition to the release of chemicals to the environment, which may contaminate soil and/or water • when vehicles reach their destination, they must be unloaded. Many accidents have occurred in which road or rail tankers have been unloaded into the wrong tank. The reasons for this are numerous: ▪ the road tanker has gone to the wrong destination, and because the recipient was expecting a delivery, the assumption was made that the load was the expected chemical ▪ the road tanker arrived at the right facility, but was sent to the wrong discharge point ▪ the identity of the chemicals was mistaken, *e.g.*, chlorine bleach and hydrochloric acid were confused, and the load was discharged into the wrong tank • if a transport container (tank, drum, etc.) is overfilled, then this can have serious consequences: ▪ if containers are overloaded, then the structural integrity of the container may be endangered and it may collapse and release the chemicals ▪ if containers are overloaded, then the vehicle may be overloaded and, therefore, its integrity endangered, apart from making the vehicle more difficult to control (brake, steer, and manoeuvre) ▪ overfilling with gases or liquids can lead to the release of hazardous chemicals if there is a sudden change of temperature, due to the thermal expansion of the material. If loads are transported long distances, then temperature changes of more than 40°C are easily possible
Pipelines carrying hazardous chemicals including oil and gas pipelines	• as pipelines run over long distances, the volumes blocked-in by two valves may be very large (distances typically over 10 km). Therefore, any damage to the pipelines has the potential to release very large amounts of chemicals • for underground pipelines, the risks of damage are due to: ▪ corrosion ▪ overloading from above (*e.g.*, heavy vehicles, building works) ▪ damage during excavation for construction work or work on other pipelines, cables, etc. • for above-ground pipelines, the risks of damage may be due to: ▪ sabotage or vandalism with the aim of theft of the product being transported ▪ corrosion due to the environment ▪ impact with vehicles or other moving objects • pipelines may also be damaged by changes in the ground and its stability due to: ▪ earthquakes ▪ subsidence due to mining activities ▪ (seasonal) melting of the permafrost ▪ flooding

TABLE III:
Loss of Containment

To prevent chemical accidents, it is necessary to identify and understand the hazards associated with chemical substances and their processes, as well as potential scenarios which may lead to an accident.

The investigation of past accidents has shown that it is rare for a chemical accident to have just one cause. Usually, there is a combination of factors including technical, organisational, and managerial failures.

The following three tables describe accident scenarios, with respect to three stages:

a. events or processes which may lead to a loss of primary containment, but can be controlled if identified and understood;
b. loss of primary containment, through which energy or hazardous substances are released into the surroundings; and
c. consequences or effects, which are dependent on the amount of energy or substance released and on the type, as well as the proximity, of people, sensitive environments, or property to the release.

TABLE IIIa:
Typical Events or Processes which May Lead to a Loss of Primary Containment (Precursors)

Event / Process	Description	Control Mechanism
Corrosion	Loss of material from the walls of piping, tanks, and other fittings in an installation due to chemical reaction (also with the atmosphere)	Correct choice of suitable construction materials, knowledge of expected corrosion rates, regular inspection
Erosion	Loss of material from the walls of piping, tanks, and other fittings in an installation due to mechanical abrasion	Correct choice of material, understanding of the effect of different flow characteristics on the loss of material, regular inspection
Overfilling	Loss of control of the flow of material into a (storage) unit in relation to its maximum capacity	Use of reliable gauging and metering equipment to establish the filling level, implementation of standard operating procedures for the processes, fitting of sufficient, reliable overfill protection systems
Overpressure	Overpressure resulting from expansion of the contents of a vessel due to heat, or due to an uncontrolled chemical reaction within the vessel (*e.g.*, polymerisation or decomposition)	Maximum filling levels should take account of expected thermal expansion due to seasonal temperature changes; vessels should be protected against the effects of fire; fuel storage tanks should be fitted with pressure/vacuum valves to prevent the build up of a dangerous overpressure whilst filling the tank Pressure vessels should be fitted with suitable pressure relief systems
Inadequate “management of change”	Inadequate management of change can lead to the release of hazardous chemicals. By changing equipment, chemicals, material, operating procedures, employees, manning levels, etc. changes are made in the hazards and risks associated with the process	Identifying intended changes before they are implemented Assessment of the safety relevance of any changes Taking suitable measures to deal with changes in hazards and risks Communicating the changes to the workforce and management

Table IIIa: Typical Events or Processes which May Lead to a Loss of Primary Containment (Precursors) *(continued)*

Event / Process	Description	Control Mechanism
Inadequate "management of change"		*(continued)* Companies need to be aware that changes in manning levels, maintenance levels, financial security, company structure can all have an effect on the safety of a facility
Vacuum	Flat bottom tanks (and other equipment not designed for vacuums) may not withstand even slight vacuums, which may lead to the collapse of the equipment and release of hazardous substances	Tanks should be fitted with PV-valves to prevent the creation of a hazardous vacuum due to cooling, or discharge operations. The size of the valve should be appropriate to the discharge flow rate and must be regularly cleaned and maintained
Mechanical damage	The function or integrity of equipment may be damaged by the impact with objects (vehicles, load on cranes, etc.) or by the inappropriate use of tools, *e.g.*, use of hammers to tighten screw couplings	Equipment should be protected from moving vehicles, transport routes on site should be defined, the use of cranes and control of their loads must be clearly regulated, and suitable tools should be provided for carrying out manual work
Unexpected chemical reactions	Loss of control of exothermic chemical reactions, spontaneous polymerisation, spontaneous decomposition, spontaneous crystallisation, etc. may all lead to chemical accidents	It is important to understand the kinetics of the chemical reactions carried out, using calorimetric data Adequate cooling and pressure relief should be provided for the chemical reactor The consequences of changes in concentrations and impurities on the reaction rate and pathways should be assessed and documented
Effects of extreme weather conditions or seismic events	The impact of extreme weather conditions (extreme wind, rain, snow, heat or cold, lightening) or seismic events (earthquake, tsunami, volcanic eruption) or similar on chemical installations can damage the physical stability of the plant construction or lead to a break down in the supply of energy or utilities. This may in turn lead to chemical accidents	The siting of hazardous installations should take account of local natural features (rivers which may flood, steep slopes prone to avalanche or mud slide, etc.) The construction of installations should take account of the expected weather conditions in the geographical region, including extremes Emergency procedures should be in place to deal with foreseeable consequences of natural events Provisions should be made for shutting down the installation in an emergency due to extreme natural conditions
Human error in maintenance or operation	Human error due to misunderstandings, or inability or incapacity to operate can lead to chemical accidents	The necessary qualifications for operating and maintaining the installations should be defined Employees should be provided with the necessary, regular training and clear procedures to ensure that the installations are properly maintained and operated

Table IIIa: Typical Events or Processes which May Lead to a Loss of Primary Containment (Precursors) *(continued)*

Event / Process	Description	Control Mechanism
Mistaken identity of chemicals	Mistakes made in identifying chemicals or the tanks, or with connecting pipework associated with them, can lead to chemical reactions with the release of hazardous chemicals, fire, or explosion. A common incident is to combine sodium hypochlorite solution (chlorine bleach) with an acidic solution (*e.g.,* hydrochloric acid, iron (III) chloride – used in water treatment) with a resulting release of chlorine gas	Training for the operators, so that they understand the potential hazards and the need for the correct identification of the chemicals Clear labelling of all chemicals, tanks, and connections (particularly at loading/unloading units) Clear procedures and two-person control for potentially hazardous transfer operations
Collapse of structures (*e.g.,* tanks) due to loss of stability	A number of accidents have occurred in which structures have collapsed because they have lost mechanical stability. The ground and/or foundations on which they stood has been washed out and, due to the cavity created below a structure, it eventually collapsed. Two particular phenomena are worth consideration: a. leaks from underground pipelines below or in close proximity to the structure. In such a case a release of water or waste-water may be sufficient to undermine the stability of a tank. Corrosion of the pipe or poorly made joints may be the cause of the leak or mechanical damage due to overloading, impact, etc. b. leaks from the tank (hazardous substance) due to corrosion in the base of the tank may release liquid below the foundations. If the foundations are a ring, rather than a closed concrete base, then the leak can wash out soil/sand below the ring and the tank will collapse (fall over) releasing the contents of the tank	The effects may vary from the total loss of containment due to the collapse of the tank, to the loss of hazardous material to the soil (through corrosion leaks in the tank base). The secondary consequences may vary depending on the characteristics of the hazardous substance stored in the tank
Inadequate operational control	If there are inadequate procedures, instructions, or training (*e.g.*, they are incomplete, erroneous, misleading, or out-of-date), the operating personnel may be unable to carry out their tasks in an appropriate way and may not understand the correct mode of action or the associated hazards. This can lead to failures, and exposure of people and the environment to hazardous substances	Operational control should be regulated within the safety management system, and mechanisms established for defining operating procedures. These should include document control to keep procedures up-to-date, and appropriate training/retraining to ensure that workers continue to be able to carry out their duties in a safe manner
Failure of components	Even within well-operated and maintained installations, components may fail due to, for example, wear, unexpected loading, and the uncertainties related to mechanical design	The overall design of the installation should be that failure of equipment should, as far as possible, not lead to the damage of other components or the uncontrolled release of hazardous substances. This involves, *e.g.*, adoption of inherently safer technologies as a principle for process design, or use of "fail-safe" equipment which when it fails it leads to a safe condition such as an automatic closure of valves when there is a loss of power

TABLE IIIb: Loss of Primary Containment

Loss of primary containment	Description
Release of pressure through relief valve	This is the intended mode of operation; however, it is necessary to be aware of which hazardous substances may be emitted and their impact zones
Failure of pipework	Pipework can fail due to a number of causes. The extent of failure can range from pinhole leaks (*e.g.*, due to corrosion or erosion) to maximum releases (*e.g.*, 2F guillotine breaks)
Failure of seals	Between sections of pipework, valves, vessels, and other equipment, seals made of various materials are used to ensure the integrity of the containment of hazardous substances within the installation. If seals fail due to fatigue, damage, incompatibility with chemical substances, overpressure, etc. then a loss of primary containment can occur
Bursting due to overpressure	Overpressure within a vessel or an enclosed section of pipework beyond the constructive design pressure can lead to failure and release of hazardous substances
Collapse due to vacuum	Vacuum applied to a vessel (due to *e.g.*, temperature fluctuations or discharge of liquid from a tank) can lead to the failure of an installation and the release of hazardous materials
Open pipework/vessel due to maintenance/operating error	In maintenance activities or particular process steps within normal operation, the installation or pipework may have to be opened. If the necessary measures to ensure that this is carried out in the correct way are not adopted then a release of hazardous substances may occur from, *e.g.*, pipework (2F release under operating pressure), open man-hole

TABLE IIIc: Consequences of Primary Loss of Containment

Consequences of primary loss of containment	Description	Criteria for determining effects
Fire	Release of flammable gases, vapours, or liquids into the atmosphere in the presence of sources of ignition (*e.g.*, hot surfaces, motors, electrical switches) can lead to fire	• Thermal radiation
Explosion (VCE, UVCE, BLEVE)	Release of a flammable gas into the atmosphere with ignition of the mixture may lead to a fireball and pressure wave. This is known as a vapour cloud explosion (VCE). If this takes place away from buildings, plant, etc. it may be an unconfined vapour cloud explosion (UVCE) for which estimation models exist. Confined VCE lead to higher peak over pressures and are more complex to model If a pressure vessel containing a liquid, *e.g.*, LPG, is exposed to fire, a so-called Boiling Liquid Expanding Vapour Explosion (BLEVE) may occur, which bursts the tank and in the case of a flammable liquid is also accompanied by a fireball and the spread of flammable gas	• Over pressure • Thermal radiation

Table IIIc: Consequences of Primary Loss of Containment *(continued)*

Consequences of primary loss of containment	Description	Criteria for determining effects
Release of toxic gas	The release of a toxic gas can have an effect on the local population and environment at considerable distances from the point of release. This depends on the physical-chemical characteristics of the hazardous substance and on the toxicity of the gas, as well as the exact location, height, direction, and type of release involved. Gas dispersion models exist which allow estimates of the distance to which particular effects may be expected	• Gas dispersion models (require information about the toxic gas, and the release itself) • Toxicity data, *e.g.*, AEGL (Acute Exposure Guidelines) or ERPG (Emergency Response and Planning Guidance) values (these values give concentration levels related to duration of exposure and the expected toxic effects)
Release of hazardous liquid to water or soil	The failure of pipework or vessels may lead to liquids being released in large quantities. If this is outside of the planned retention volumes then there is a risk of contamination of soil or water courses. Also fire-fighting measures may result in large volumes of hazardous liquids which pose a risk to the environment or to drinking water supplies Where possible, measures should be adopted to contain liquid releases within the designed containment areas. Emergency measures should be planned for erecting temporary dykes and retention pools, and for recovering hazardous liquids and preventing contamination of the environment or drinking water supplies	The criteria may be quite varied and include: • River flow rate with regard to the dispersion of a contamination to surface water • Drinking water permitted levels of contamination, when assessing the potability of water • Degree of contamination of crops or vegetables with regard to the suitability as animal feed or for human consumption • Assessment of the biodegradability or persistence of the contamination when considering exclusion zones or remediation • Levels of ecotoxicity for various species, when considering the longer term effects of chemical contamination
Release of large mass of liquid or flowing solid	Explosions or other mechanical damage to installations may result in the release of large masses of liquid or flowing solid. These secondary releases may not necessarily be normally considered "hazardous," *e.g.*, the destruction of a grain silo by a dust explosion may lead to an avalanche of grain which can drown workers in the immediate area	• The consideration of the impact of fire or explosion on the stability of installations together with their possible impact on the surrounding area
Flying debris (causing other accidents)	Debris from equipment failure or explosion may lead to secondary damage of other equipment and installations, with a further release of hazardous substances with the potential for fire, explosion, or toxic releases	• Models are not readily available. Experience has shown, for example, that gas bottles (such as LPG) rocket about 150 m when engulfed by fire
Lost production time	This can be one of the largest financial consequences. The accident may result in loss of personnel, equipment, installations, product, and/or production capacity resulting in reduction or stopping of operations (on a temporary or permanent basis)	• Lost production is measured in days of production and cost per day (in dollars/euros) as the value of production

Chapter B:
HOW TO DEVELOP OR IMPROVE A CHEMICAL ACCIDENTS PREVENTION AND PREPAREDNESS PROGRAMME

B1: Introduction

This Chapter sets out a process for developing, implementing, and/or reviewing a chemical accidents programme, which any country can adapt to its own circumstances.

This process consists of five phases, each containing a number of steps. A summary of each of these phases is shown in Table IV (Stages in the Development and Implementation of a Chemical Accidents Programme) on page 30. A fictitious example is presented to illustrate how a country might implement some of these steps.

Although the steps are presented in a certain sequence, it is important to recognise that this is an iterative process and it may be necessary to revisit or repeat steps at different points. Furthermore, certain steps are continuous in nature including, for example, the need to get and keep political commitment and the need for cooperation among key stakeholders within and outside government.

The final phase addresses the need for any chemical accidents programme to be reviewed periodically and revised, as appropriate, to take into account relevant changes in law, technology, nature of the risks, experience, resource availability, industrial development, population size or distribution, and other significant events.

The process set out in this Chapter is meant to be flexible so that it can be adapted by:

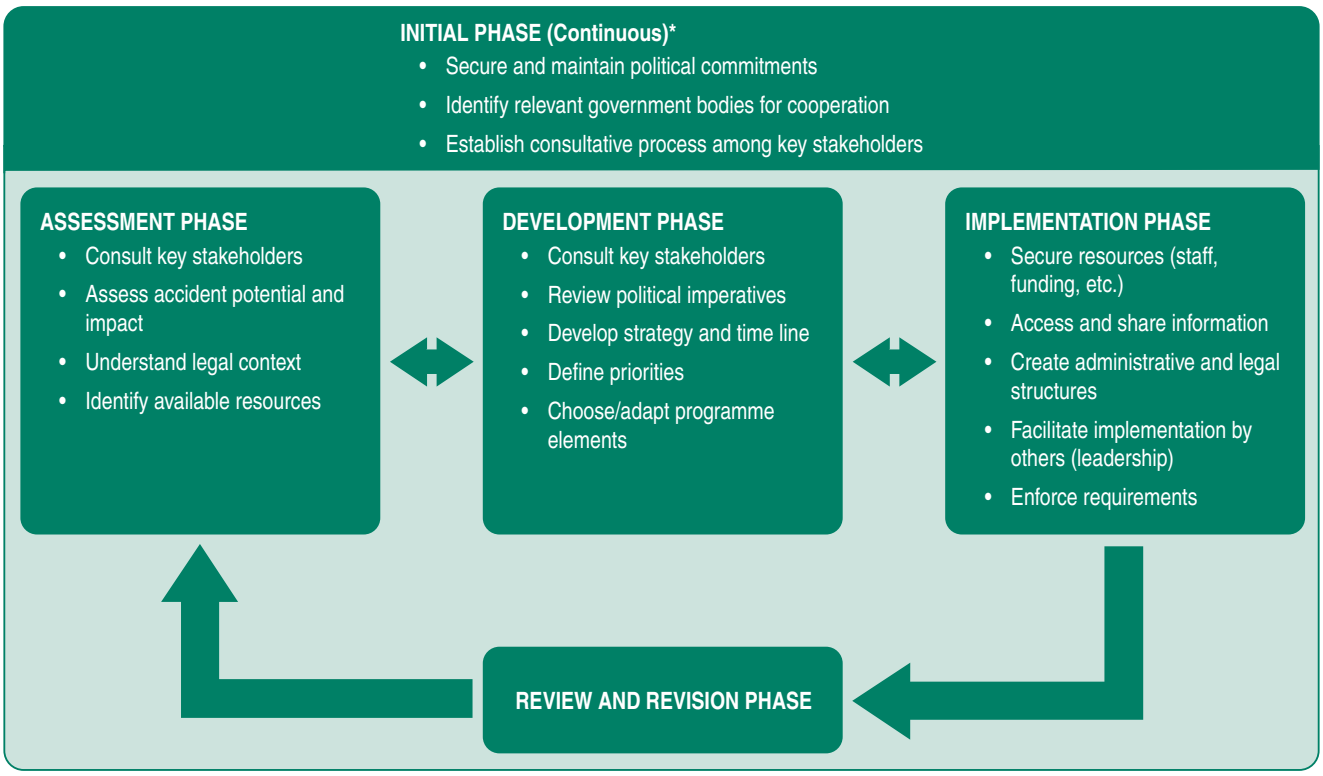
- countries that do not have chemical accidents programmes or have limited legal or policy instruments that relate to chemical safety;
- countries with existing capacity that wish to assess and, as appropriate, strengthen their programmes;
- countries with a limited number of hazardous installations; and
- countries with significant industry involving hazardous installations.

In addition, this process is designed to be flexible to allow each country to develop a programme that is consistent with its regulatory culture, and its own procedures for the development or revision of legal instruments and policies.

It is recognised that countries have different systems and procedures for developing legal instruments and government policies, particularly, with respect to which bodies are involved in initiating and drafting laws, regulations, policies, and other instruments.

Therefore, it is important for each country to consider how to adapt this *Guidance* to work within its own legal, regulatory, and cultural context.

TABLE IV:
Stages in the Development and Implementation of a Chemical Accidents Programme



*These activities should be continued and sustained throughout the other phases of the project as well.

FICTITIOUS EXAMPLE OF USING THIS *GUIDANCE*
TO DEVELOP A CHEMICAL ACCIDENTS PROGRAMME

Note: An example is used in this Chapter to illustrate how one fictitious country might use this Guidance*. Boxes are included throughout this Chapter with information on how "Country X" is moving forward with its effort to develop a chemical accidents programme. This example is meant just to be illustrative. It is critical for each country to figure out how best to adapt this* Guidance *to meet its own specific needs and circumstances.*

BACKGROUND

Country X is a developing country. It is primarily agricultural and is planning to attract new industry in the next decade. It currently has one pesticide manufacturer and a pesticide formulator, as well as a number of large storage facilities. It also has one refinery, and a large port servicing landlocked countries to the east.

Country X has not had any significant chemical accidents over the past eighteen months. However, neighbouring countries have had several serious chemical accidents with off-site deaths and environmental damage. One of these was on the border and contaminated a lake in Country X, resulting in significant loss of fish stocks.

The Minister of Civil Defence concluded that Country X should create a chemical accidents programme to improve accident prevention and preparedness, and to provide a platform for exchanging information and experience with neighbouring countries. He was informed of the UNEP effort to create the "Flexible Framework," and has been reviewing the UNEP *Guidance* as well as other international initiatives including the ILO Convention 174 and related ILO guidance, WHO publications including the *International Health Regulations* (2005), UNECE materials and the OECD *Guiding Principles for Chemical Accident Prevention, Preparedness and Response* (2nd ed., 2003).

B2: Initial Phase

This Initial Phase consists of three steps, leading to the development of a workplan for moving forward:

a. **commitments:** getting (and maintaining) the necessary governmental commitments to create or improve a chemical accidents programme, including an allocation of personnel and resources needed for moving forward;

b. **cooperation:** identifying all relevant government bodies and ensuring appropriate cooperation throughout the process; and

c. **consultations:** establishing a mechanism for consultation with non-governmental stakeholders (industry, workers, communities, other non-governmental organisations).

The workplan that results should include an agreed written statement of intent as well as a schedule of anticipated activities (discussed in the assessment, development, implementation phases as well as Annex IV (Consolidated List of Activities for Developing a Chemical Accidents Programme) on page 160) and milestones.

a. Commitments

For the effort to create a chemical accidents programme to be successful, it is critical to have continuing political commitment, in addition to the means and the intention to implement the programme in a meaningful way.

Therefore, there needs to be agreement by the appropriate high-level authority(ies) that a "chemical accidents programme" should be developed (or revised) and that efforts in this regard will receive the necessary political support and an appropriate resource allocation (including personnel and a budget).[16]

As part of this process, it is important to consider the resources that will likely be needed during the process of assessment and development of the chemical accidents programme. This includes, for example: what competencies are needed; where staff are available with appropriate expertise within the government and in the private sector; how much time should be allocated for this work; and whether there is a need to hire consultants to undertake specified tasks and, if so, how this can be financed.

Initial Phase: Commitments, Cooperation, and Consultations GOALS and ACTIVITIES

GOALS:

- Put into place all the political and administrative prerequisites needed to develop, improve, or review a chemical accidents programme.
- Prepare a workplan for developing the programme.

SUGGESTED ACTIVITIES:

- Secure the appropriate political commitment for this effort.
- Identify key government authorities at national, regional, and local levels and establish a process for cooperation.
- Organise consultations – within government and with other stakeholders – to raise awareness and undertake assessments of risks and needs.
- Identify resources needed (people, funds, time) for each stage of the process of developing or reviewing a chemical accidents programme.
- Develop a written statement of intent and workplan including a schedule and milestones.

It is not possible to provide guidance on who is the "appropriate authority(ies)" in each country for purposes of getting this political commitment. In some countries, the commitment may need to come from the legislative branch; in others, it may be from the management of a key agency or ministry. In some countries, the environment agency will have the lead on this subject; in other countries it might be the civil defence authority, the industry ministry, or another body.

[16]This refers to an interim budget and staff allocation, to deal with the assessment and development phases. It is not possible to estimate the full cost of implementing the chemical accidents programme from the outset. This can only be done after later stages in which the level of risk is identified, priorities established, and other analyses undertaken.

It can be difficult to get the attention of political leaders, especially if there has not been an accident in the recent past. Therefore, it is important to make the case by increasing understanding of the risks of accidents, and the cost to human health and the economy in the event of a major accident.

Possible ways to get and maintain the interest of political leaders include:

- describing the relationship between chemical safety and sustainable development;
- providing data showing that the cost of safety is less than the cost of accidents;
- noting that chemical safety is not an obstacle to progress and, in fact, might attract business;
- recognising that a chemical accidents programme may have economic benefits in terms of, for example, increasing the efficiency of operations and facilitating access to financing; and
- identifying links to international agreements (such as the ILO and UNECE conventions and the WHO Health Regulations) and initiatives in this area (including cooperative frameworks such as SAICM, IOMC, Intergovernmental Forum on Chemical Safety (IFCS), etc.). In this regard, ratifying a convention or actively participating in international activities may provide a means for accessing additional resources to support a national chemical accidents programme.

It is important that the political commitment is maintained so that the process can be completed and that the resulting programme has the support needed for implementation.

b. Cooperation among Government Bodies

Cooperation among the agencies, ministries, and other relevant government bodies is another key to success. Being inclusive should be the goal, with a system in place for regular consultations.

To achieve this, it is important to identify all the relevant authorities and establish a consultative process.

Continuing involvement and coordination is important because issues associated with chemical accident prevention and preparedness are the concern of many different government authorities at national, regional, and local levels including those responsible for: environmental protection; occupational health and safety; public health; civil defence; emergency response (fire, police, medical, HAZMAT); land-use planning; and industrial development. Coordination also helps to minimise any conflicts or overlaps with existing policies or legal requirements.

In addition to national authorities, consideration should also be given to which bodies at local or regional level have roles and responsibilities and how they should be involved in the process. For example, in many countries land-use planning, monitoring installations, emergency preparedness, and/or accident response are the responsibilities of local or regional authorities.

Each country should consider how the cooperative effort can best be initiated and maintained, taking into account local customs and practices. For example, to start the process a consultative meeting could be organised, chaired by an independent party. Alternatively, a lead agency might be identified which can convene a meeting with other authorities, or there may already be an inter-agency task force that could be charged with initiating discussions. In some cases, it may be necessary to get a specific legal authority in order to create an inter-agency body with responsibility for such cooperation.

c. Consultations with other Stakeholders

Experience has shown that a chemical accidents programme benefits from the active involvement of key stakeholders including representatives of: the enterprises that manage hazardous installations; workers from such installations; industry organisations; trade unions; and communities in the vicinity of hazardous installations. In addition, there can be valuable resources and competencies in universities, research institutes, health care facilities, environmental groups, and other non-governmental organisations. UN agencies and other international organisations represented in the country can also be a valuable resource when developing a chemical accidents programme. Additional information on stakeholder consultation is presented in Text Box 3 (Consultation with Key Non-Governmental Stakeholders) on page 34.

Mechanisms should be established for regular consultations with these stakeholders, on a continuing basis, and for creating the sense that this is a joint effort to achieve common goals. The consultations should start early in the process of assessment and development of the chemical accidents programme.

Building partnerships with these stakeholders will result in a sense of ownership leading to more effective implementation of the programme by those with roles and responsibilities related to chemical accident prevention and preparedness.

Text Box 3

CONSULTATION WITH KEY NON-GOVERNMENTAL STAKEHOLDERS

Consultation and coordination are critical to the successful development and implementation of a chemical accidents programme. When determining priorities and developing a plan of action, it is extremely valuable to get input from key stakeholders, including different agencies with relevant responsibilities as well as representatives of industry, workers, non-governmental organisations, and communities in the vicinity of hazardous installations. It is also important to involve individuals with expertise in key areas, such as chemists, process engineers, and safety specialists.

There are many advantages to consulting with non-governmental stakeholders. Often, these stakeholders will have critical information that is not generally available to authorities. Furthermore, various stakeholders have insights on what sort of regulatory approaches might be most effective in practice. Another benefit is that the stakeholders will more likely comply with (and even promote) the requirements and recommendations if they were part of the development process. And non-governmental stakeholders are often a good bridge to the communities potentially affected in the event of an accident.

There are various ways to ensure adequate consultation, and countries may choose to use one or several ways. One approach is to make relevant draft documents public, with an opportunity for the public to review and comment on the drafts. Another approach is to hold a series of public meetings in various locations, or to have small working groups with representatives of various stakeholder groups.

FICTITIOUS EXAMPLE
INITIAL PHASE

Informal Consultations: The Minister of Civil Defence is committed to moving forward with development of a chemical accidents programme and asked his deputy to initiate a process to develop a new approach to chemical accident prevention and preparedness.

The deputy began by convening an informal meeting of representatives of key agencies to see if others agree that addressing chemical accidents should be a priority and, if so, to brainstorm on how to move forward. Attending the meeting were officials from the Ministry of Civil Defence, Ministry of the Environment, Ministry of Health, Ministry of Labour, the fire service, and the police.

The deputy also invited an international expert from UNEP to discuss the subject of chemical accident prevention and preparedness. The expert provided insights on how to assess risks as well as on the environmental, health, and financial implications of chemical accidents. In addition, she shared the experience of other countries in addressing accident risks. The UNEP representative also described the guidance materials that are available to support countries' efforts and explained what international resources may be available to assist Country X.

At this initial meeting, there was a consensus that Country X should move forward to identify the risks in their country (now and expected in the future) to determine what elements of a chemical accidents programme would be appropriate. It was also agreed that the Ministry of Environment (MoE) should take the lead in close cooperation with the Ministry of Health (MoH). There were several reasons for this decision; the primary one was the need to understand the risks associated with chemicals. In addition, the MoE has some resources and staff that could be re-assigned to this effort including chemists, an environmental expert, and a chemical engineer while the MoH could provide epidemiological and toxicological expertise.

The meeting concluded that they should create a Chemical Accidents Task Force and that the first meeting of the Task Force should be convened within the next two weeks. Each of the agencies agreed to participate and to include, if available, technical specialists such as chemists and engineers.

Fictitious Example – Initial Phase *(continued)*

The meeting also decided that the Task Force should include representatives from a number of additional organisations, such as:

- other government bodies including the Ministry of Agriculture, the Justice Ministry, and the Energy Agency;
- port authority personnel;
- representatives from local government agencies responsible for emergency medical response and for inspections of workplaces;
- companies that own the country's hazardous installations (including management and workers);
- doctors from the emergency medical response team;
- engineers and chemists from the national university; and
- non-governmental organisations including the chamber of commerce, trade unions, and the largest environmental groups.

First Meeting of the Task Force: The Policy Director (PD) at the Ministry of Environment was put in charge of this effort. PD and his staff sent out the notices and created an agenda for the first official meeting. The focus of this meeting was to:

- introduce participants, with each providing a description of their organisation's roles related to chemical accident prevention and preparedness;
- discuss, in general terms, the nature and extent of risks in the country and accident history;
- consider who else should be involved in the process;
- develop a plan for moving forward, allocating responsibilities to different parties, and establishing a time line for achieving interim milestones;
- establish subcommittees for various tasks;
- agree that three reports should be prepared for review at the next meeting of the Task Force. These reports would address: the chemical accident potential in Country X; the current state of the country's laws and regulations, as well as the availability of resources for implementing these; and existing approaches for chemical accident preparedness and response in other countries and related international initiatives; and
- secure any additional resources, including expertise, needed.

The meeting concluded that by pooling resources from the Ministries, they had sufficient staff and financing to move forward with this effort. In addition, they established the subcommittee responsible for assessing accident potential and agreed that the report should be completed within three months. At the same time, the Justice Department was assigned to outline the existing laws, regulations, and policies related to accident prevention and preparedness. The university representative offered to prepare the report on the existing approaches from other countries and international initiatives, using UNEP's *Flexible Framework Guidance* as a guide.

It was agreed that a second meeting of the Task Force would be held in four months.

B3: Assessment Phase

The Assessment Phase consists of three steps, designed to gather information as a prerequisite for clarifying priorities and making decisions about the scope and content of an appropriate chemical accidents programme.

Specifically, this phase addresses:

a. **accident potential:** assessing the nature and extent of the risk of chemical accidents in the country;

b. **legal context:** identifying what legal instruments and policies are already in place that can be used to address aspects of a chemical accidents programme, which organisations are responsible for implementing these, and what gaps exist; and

c. **available resources:** determining what resources may be available within government, and what programmes and resources exist outside government, that may be available to support a chemical accidents programme.

Armed with this information, countries can: identify what legal and policy instruments might need to be amended, updated, or supplemented; understand inter-linkages and overlaps; recognise opportunities for improving implementation and coordination; and identify gaps that should be addressed. The information helps countries make an informed political decision on what actions would be most appropriate in light of the resources available within a certain time-frame and how to make most effective use of these resources.

During this phase, it is important to maintain cooperation among relevant government bodies, and to ensure continuing opportunities for consultation with key non-governmental stakeholders including representatives of industry, workers, communities, and others. These consultations will help provide insights into the risks, resources, and political imperatives that need to be taken into account. Furthermore, the involvement of key stakeholders should also significantly aid in their participation when it comes time to implement the chemical accidents programme.

a. Accident Potential

At this stage, the goal is not to have a complete inventory of hazardous installations (which can be done as part of the programme implementation). Rather, the focus should be on getting insights on the nature and extent of local hazards and risks including the vulnerable populations and environment.

This assessment will be critical in both defining the scope and content of the chemical accidents programme, and in establishing a schedule and setting priorities for implementation. More information is provided in section B4 (Development Phase) on page 41).

Generally, this assessment can be done by collecting and analysing information that is available in government records. It is also valuable

Assessment Phase
GOAL and ACTIVITIES

GOAL:

To gain a general understanding of: the nature and extent of the risks of chemical accidents in the country; the existing legal and policy context related to chemical safety; and the resources that might be available to support a chemical accidents programme.

SUGGESTED ACTIVITIES:

- Consult with stakeholders.
- Consider the questions identified in this *Guidance*.
- Identify sources of information available from within government agencies, local authorities, and other sources (including industry records).
- Assign expert(s) to collect and review the information.
- Establish criteria/models to determine which installations are of greatest concern.
- Prepare a list of installations of concern, and, if possible, identify the most important and map their location.
- Survey mandates of relevant government bodies.
- Survey existing programmes, laws, regulations, policies, international obligations, and other instruments (assess these to identify overlaps, gaps, inconsistencies, etc.).
- Identify resources that might be available (human, financial, technical, etc.) from within the country or from outside sources.
- Develop a matrix, table, database, or report with this information.

to engage the private sector, which will have information about their activities and will likely have expertise in assessing risks.[17]

The types of information that could be helpful to determine accident potential include: listings of all industrial facilities; records of the quantity of chemicals manufactured and imported in the country; information on the percentage of industry that uses and handles hazardous chemicals; chemical data profiles that collect information on the nature and extent of chemicals in the country;[18] and general industry and trade data.

In addition, local authorities and fire services may maintain inventories of industrial facilities or other records of interest. Non-governmental organisations (such as industry associations, research institutions, and environmental groups) also might have relevant information.

Anecdotal information can also be used to generate this general understanding of local accident potential.

The following questions could be helpful in undertaking the assessments:

- Which hazardous installations in the country pose the greatest risks? In addition to manufacturing facilities, these might include warehouses, refineries, mining-related activities, waste or water treatment facilities, ports, or other transport interfaces.
- Are there types of hazardous installations that are widespread in the country? These might include pesticide storage, pipelines, or certain small businesses that use toxic, flammable, or environmentally hazardous chemicals.
- What hazardous chemicals are produced, imported, or used in the country (Annex III (Lists of Chemicals of Concern) on page 143 contains lists of chemicals and procedures used by European Union countries, as well as the US, Switzerland, and Korea to identify installations covered by their accidents regulations)?
- Where are hazardous installations located (are they primarily in urban or rural environments; are they close to population centres or sensitive environmental areas including rivers and other water sources)?
- Are there installations that may be involved in domino effects (*i.e.*, an accident at one facility has the potential to initiate an accident involving hazardous chemicals at another facility)?
- What industrial development can be expected to occur in the near future that might involve hazardous substances?
- What has been the accident history in the country or neighbouring countries (that might predict future problems)?
- Is there a potential for natural disasters that might cause or contribute to chemical accidents (such as earthquakes, fires, hurricanes, floods, tsunamis)?
- What types of adverse impacts might be expected should an accident occur (immediate and over the longer term, direct and indirect)?
- What response plans and resources are available in the event of an accident?

In addition, it is important to take into account any pragmatic or political imperatives or constraints. For example, if there have been highly publicised accidents in other countries, there may be pressure on a country to address the same type of installations as a priority even if an objective analysis concludes that it is not posing the greatest risk.

This assessment of accident potential should be reviewed and updated periodically in order to take account of any relevant changes in industrial and other developments, new information, and experience.

b. Legal Context

A review of existing laws, regulations, policies and other instruments, and the associated infrastructure, will provide a basis for understanding what aspects of accident prevention and preparedness are already being addressed.

It can also identify instruments and policies that might be adapted or expanded to address accidental risks. Depending on the country's procedures, it may be simpler to adapt or expand existing regulations, policies, and programmes than it would be to create new ones.

---

[17]Tables I (page 14), II (page 21), and III (page 23) in Chapter A may help in identifying potentially hazardous installations.
[18]See Text Box 4 (National Chemicals Management Profiles) on page 38 related to the UNITAR programme to support countries in developing National Chemical Profiles.

Text Box 4

NATIONAL CHEMICALS MANAGEMENT PROFILES

Through its National Profile Support Programme, UNITAR provides guidance, training, and technical support to assist countries in assessing their relevant legal, institutional, administrative, and technical infrastructures related to the sound management of chemicals.

By January 2010, some 140 countries have prepared, or are preparing, a National Profile following the UNITAR/IOMC National Profile Guidance Document. At the international level, National Profiles provide others with a better understanding of the existing capabilities of countries, as well as their needs. See: http://www2.unitar.org/cwm/nphomepage/index.html.

While National Profiles address a broad subject area and can assist with identifying national priorities, they can also provide important insights during the development and implementation of a chemical accidents programme (*e.g.*, through the inclusion of a new chapter on "Chemical Emergency Preparedness, Response, and Follow-up" that is being included in a revised Guidance Document).

This review will also aid in identifying gaps and in developing any new legal or policy instruments. The assessment will enable any new instruments and policies to build on existing capabilities, and effectively integrate into the existing context.

As part of this review process, there should be consultations with all relevant authorities and other bodies to gain an understanding of how relevant instruments are being implemented/applied. In many countries, laws and regulations are in place but are not being effectively implemented. In such cases, it is important to ask whether these laws and regulations are valid and appropriate and, if so, what is hindering their implementation.

There are several issues that can be helpful to consider during this review, including:

- What aspects of chemical accident prevention and preparedness are already regulated or otherwise addressed in legal and policy instruments or programmes? Consider which instrument(s) and programme(s) might be applied to accidents issues in the future even if they haven't in the past, such as those which address general chemicals or environmental safety, civil defence, occupational health and safety, land-use planning, etc.
- Are relevant legal and policy instruments and programmes being effectively implemented?
- What is the experience with enforcement of any relevant instruments?
- Are there existing or potential overlaps or inconsistencies/conflicts (*e.g.*, this might include overlapping reporting requirements, duplicative inspection programmes, etc.)?
- What are the country's international obligations (*e.g.*, is it a signatory or a party to a convention dealing with chemical safety or accident issues, is there a bilateral agreement with a neighbouring country)?
- Are there any relevant interagency task forces or committees already in place?
- What relevant voluntary or non-governmental initiatives exist in the public or private sector (*e.g.*, responsible care programmes, agreements among enterprises within a geographic area, etc.)?

It is helpful to collect the information gathered during this assessment in a matrix which identifies each existing legal or policy instrument, its scope and objective, the responsible ministries or agencies, other stakeholder involvement, and any other relevant information about content and implementation.

c. Available Resources

This review should focus on gaining an understanding of the resources that are available for the implementation and enforcement of current requirements, policies, and programmes (both within and outside government), as well as the resources that might be available for any new commitments.

For this purpose, relevant resources include:

- staff that has appropriate experience or can be trained so that they are competent for assigned responsibilities;
- funding (*e.g.*, the type of budget available to public authorities assigned responsibilities under laws, regulations, policies, and other instruments);

- expertise from outside of government, for example from industry, universities, research institutes, consultants, and non-governmental organisations. Such external resources are often critical, particularly during the development process or for short-term or intermittent tasks such as developing a database or running periodic training programmes;
- technical resources, such as computers, software, facilities for communication, response equipment, training supplies, etc.; and
- data and reference materials that might be needed, as well as identification of organisations that can be called on to provide information or other assistance (such as UN bodies, agencies from other countries, etc.). Annex VI (Selected Bibliography) on page 170 can be helpful in identifying some of these international resources.

It is important that this information be captured in a report that summarizes the assessment findings, and that the report presents a picture of what is actually available, or may be accessed, to address chemical safety issues. It can be tempting to create a report that identifies what should be in place rather than what is. A realistic assessment is needed to identify gaps, set priorities, and determine how best to move forward.

FICTITIOUS EXAMPLE
ASSESSMENT PHASE

The Ministry of the Environment chaired the subcommittee responsible for assessing the accident potential in their country. Recognising that there is no central government registry of hazardous installations, it was concluded that the best information for the assessment is maintained by provincial governments.

The subcommittee prepared a survey to ask provincial governments to identify facilities of concern. In developing the survey, the Ministry created criteria for determining the installations of concern by reviewing the list of substances in other countries' laws and the types of hazardous installations described in the UNEP's *Flexible Framework Guidance*.

The survey asked the provincial governments to identify, if known:

- the installations (including factories, warehouses, transport interfaces, etc.) that might create a risk of a chemical accident, identifying the nature of the risk and the size of the installation;
- the location of these installations relative to population centres, commercial or public buildings, other industry, waterways, sensitive environments;
- the history of any accidents or incidents involving chemicals over the past five years; and
- any preparedness plans and resources that are available in the event of a chemical accident.

In addition to collecting information from all provincial governments, the subcommittee reviewed import and export data and interviewed key individuals who might have insights on the nature and types of hazardous installations in their country including: exporters and importers; industry and union leaders; port authority officials; hospital staff; and officials from neighbouring countries.

After compiling the survey results, the committee consulted with experts from the national university to learn more about the risks of earthquakes, monsoons, and other natural disasters in the areas where the hazardous installations are located.

Using all this information, the subcommittee prepared a report for the Task Force identifying the key issues; describing the people, property, and areas at risk in the event of an accident; and creating a map with the known installations of concern and nearby developments. The report reached several important conclusions:

- The primary areas of concern are along the coast due to the port facilities, warehouses, and transport interfaces, as well as the population clusters located there. In addition, the coastal area is most vulnerable to flooding which could contribute to the accident risks.
- There are two large pesticide facilities, one a producer and the other a re-formulator/packager. Both these facilities were built more than 20 years ago in relatively rural areas but, since that time, significant housing and community amenities (schools, markets, playing fields) have been established near the facilities.
- There are 15 large warehouses containing bulk and packaged pesticides. While the exact mix of products change periodically, the warehouses generally store a substantial quantity of substances that are toxic and dangerous to the environment. Two of these warehouses are located adjacent to rivers.
- The refinery has had six accidental releases over the past 10 years, but only one had off-site effects causing 10 people to go to the hospital.

Fictitious Example – Assessment Phase *(continued)*

- There is one depot for explosives for use in construction of roads and tunnels.
- There is a large import and export activity at the port, but there are not good records of the quantities of hazardous substances that pass through each month. Furthermore, the port does not have good quality control procedures to help ensure that containers are not damaged.
- Each large town has substantial supplies of chlorine stored for water treatment and other purposes.

The report of the Task Force also noted that the Ministry of Industry has developed a five-year plan to attract new industry to Country X. If successful, some of this new industry would create additional chemical accident risks. As a result, the report recommended that the Ministry of Industry be included in the Task Force.

At the same time as the work to develop the study of hazardous installations, the Justice Ministry prepared a report identifying the relevant legal and policy instruments and related resources. The study identified several instruments and policies including:

- a general law that says that owners/operators of industrial facilities are responsible for ensuring that their facilities do not harm workers, the public, or the environment (known in some cases as a General Duty Clause);
- a law protecting workers from unsafe conditions, which includes provision for inspections; and
- a law giving the fire services the right to enter facilities to determine fire risks and requiring owners/operators to provide information needed for response to fires.

In addition, Country X is a party to the following Conventions:

- the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal;
- the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade; and
- the Stockholm Convention on Persistent Organic Pollutants.

The study also identified its country's instruments related to chemicals management more generally. In particular, there are regulations to address the import and export of hazardous chemicals and the disposal of hazardous waste. These were developed as part of Country X's responsibilities pursuant to the Rotterdam and Basel conventions.

The Justice Ministry report noted that Country X is an active participant in ILO activities. While they have not ratified Convention 174, they supported the effort. Country X also participates in WHO activities and works with FAO on issues related to pesticide management.

With respect to resources, the Justice Ministry looked at the ILO Convention to gain an understanding of the types of resources generally involved in the development and implementation of chemical accidents programmes (note: relevant excerpts from the ILO Convention are set out in Text Box 5 (Resources Used in the Implementation of a Chemical Accidents Programme) on page 49).

The study identified several technical experts working for the government who could be enlisted to help with the chemical accidents programme. These included four chemists and chemical engineers at the MoE, three toxicologists and medical experts from the National Poison Centre (MoH), two process engineers at the Ministry of Labour (MoL), and three trained inspectors responsible for enforcing the labour laws (MoL).

The study noted that there is a training programme for new inspectors at the MoL; however, the training provides very limited information concerning chemical risks.

The study also noted that the country's response services (fire, police, emergency medical, public health) have virtually no training in hazardous materials – HAZMAT – management.

Within the private sector, the pesticide facilities have staff who are trained in response to chemical accidents in their facilities. There are also several process and chemical engineers at the University who also work as consultants.

With respect to financial resources, the study noted that it would be difficult to get any allotment from the regular budgets of the key ministries since it would be taking funding away from other programmes. The study, therefore, suggested that the ministries jointly apply to the Ministry of Finance for extra-budgetary resources to pay for the costs of developing and implementing a chemical accidents programme.

The study included a proposed budget to be reviewed by the Task Force, as well as a matrix summarising the existing competence and relevant laws, policies, and programmes.

B4: Development Phase

The Development Phase consists of two steps:

a. **priorities:** defining priorities and establishing a realistic strategy for moving forward, taking into account the insights gained in the assessment phase, political imperatives, and consultations with key stakeholders; and

b. **programme elements:** implementing the strategy by choosing/adapting elements of the chemical accidents programme (using the overview of possible elements contained in Chapter C).

During this phase, it is important to maintain a coordinating mechanism among interested government bodies in order to avoid conflicts, ensure consistency, make best use of resources, and minimise any burden on industry. It is beneficial to establish formal mechanisms for continuing coordination and to facilitate learning from each other.

It is also important to ensure that there is a continuing political commitment to this effort and ongoing consultation with key non-governmental stakeholders to obtain valuable perspectives and gain a political consensus. There are many ways to do this and the particular approach chosen should be consistent with local culture and custom. The important thing is to be sure that there is adequate opportunity for input by all relevant stakeholder groups. Additional Information is provided in Text Box 3 (Consultation with Key Non-governmental Stakeholders) on page 34.

a. Define Priorities

As part of this step, the insights gained during the assessment phase should be used to:

- define national priorities related to chemical accident prevention and preparedness; and
- develop a realistic strategy and time line for moving forward in light of resource availability as well as the political and cultural context.

The assessments related to risks, legal context, and resources should inform any decisions on the scope of the chemical accidents programme including decisions on whether it should be based on specified chemicals or classes of chemicals with threshold quantities, whether to focus on particular industries, and/or whether to prioritise certain types of accidents or particular locations.

Development Phase GOALS and ACTIVITIES

GOALS:

- To develop a strategy and timetable for moving forward, based on a determination of priorities, resources, and the political, legal, and cultural context.
- To implement the workplan (from the Initial Phase) and create an appropriate chemical accidents programme.

SUGGESTED ACTIVITIES:

- Review the information gathered in the Assessment Phase.
- Consult with key stakeholders.
- Ensure continuing political commitment.
- Review political imperatives, local considerations, and related activities in and outside government.
- Develop a strategy for moving forward, identifying the steps to be taken, issues to be addressed, resource needs, milestones, and deadlines.
- Review Chapter C to choose elements and adapt them for the country's particular circumstances.
- Prepare a draft of the chemical accidents programme (for review by other agencies and stakeholder groups).

These assessments can also help to identify which elements of the chemical accidents programme should be further developed and implemented as a first priority, recognising that it is generally not possible to establish a comprehensive programme at one time and that a programme can be expanded as resources and experience allow. Staffing and other resource constraints need to be taken into account at this point so that any programme that is established can be effectively implemented and enforced.

The following are some examples of how a country might think about establishing priorities based on the output from the assessments:

- a country may find that they already have an effective system for labour inspections which could be adjusted to include an element of process safety and, therefore, there is no need for a new accidents inspection programme;
- a country may discover that various government bodies already collect a lot of useful information but the information is not catalogued and shared between agencies and, as a result, they conclude that a first priority should be establishing information management and distribution systems (additional information is available in Chapter C, Section C3, part (b) (Information Management) on page 70);
- given very limited resources, a country may decide to strengthen the general duty clause and impose certain responsibilities on industry while initially focusing their efforts on improving preparedness planning and outreach to communities; and
- a country may conclude that they should start with a limited scope (*e.g.*, focusing on a particular industry or one highly developed location) in order to gain experience before fully implementing their programme.

There are a number of local considerations and political imperatives that might influence decisions on priorities. For example:

- If recently there has been a series of accidents at train depots, there will be pressure to ensure that accidents at transport interfaces be addressed as a priority, even if there are other installations that pose a higher level of risk.
- The public may have concerns about certain chemicals because of well-publicised accidents in other countries putting pressure on governments to regulate these, even if they are not the most dangerous chemicals.
- In a community where providing information to the public is difficult (*e.g.*, because of a high rate of illiteracy or multiple languages in a small area), there might be pressure to allocate a higher level of resources for helping the potentially affected public be prepared in the event of an accident than would be the case where information could be easily disseminated.

b. Choose/Adapt Elements of the Chemical Accidents Programme

At this point, the country should work to implement the strategy developed in the previous step. To support this effort, Chapter C of this *Guidance* contains information on possible elements of a chemical accidents programme, such as industry requirements (notification, safety management systems, etc.), the role of authorities (information management, inspections, land-use planning, etc.), and methods for communicating with the public.

Authorities can compare the results of the Assessment Phase to the components outlined in Chapter C, as well as the priorities and strategy defined in the previous step, to identify elements of the programme that should be developed or incorporated.

Decisions concerning the content and scope of the programme should reflect a realistic assessment of what can be done given available resources – human, financial, and technical – and the political and regulatory context. It can start with a limited number of elements to address the most pressing needs and expand as experience and resources allow.

Each country needs to carefully consider how best to create and maintain its chemical accidents programme. This is not a one-time decision but, rather, an iterative process which will evolve over time. It is essential to periodically review the programme to determine whether it is achieving its goals and whether there is a need to amend or expand the programme in light of new information, changing risks, resources, priorities, and experience.

The following points should be taken into account when considering which elements to include in the programme:

- The chemical accidents programme need not be a separate, distinct programme. It can be imbedded in existing legal contexts, such as laws and programmes addressing the environment, health, labour, or other issues.

- It can incorporate existing legal and policy instruments (amended as appropriate) and/or the development of new instruments. Since it can be a time-consuming and difficult process to pass new legislation or develop new regulations, it may be more efficient to use existing legal instruments to address chemical safety, to the extent possible.
- In establishing the requirements for hazardous installations, there can be two or more different levels (or "tiers"), based on the nature and extent of the risks posed. A number of countries establish different reporting requirements, and legal obligations, for installations in lower and higher risk categories.
- Activities of non-governmental organisations (including voluntary industry initiatives, research in universities, community information programmes, etc.) that support accident prevention and preparedness as well as any further nongovernmental activities that could be promoted by government authorities.
- Integrating aspects related to emergency planning for hazardous installations with emergency planning for natural disasters (such as floods, earthquakes, and storms) and civil defence, as these activities involve many of the same requirements. It should be kept in mind that natural disasters can trigger chemical accidents at hazardous installations, and can impede emergency response activities.
- The information and support that may be available from international sources.

FICTITIOUS EXAMPLE
DEVELOPMENT PHASE

DEFINE PRIORITIES

The second meeting of the Task Force was convened to review the reports developed as a result of the Assessment Phase, and to define national priorities for action. The Task Force reviewed and discussed these reports and feedback from ongoing consultations with key stakeholders, as well as other political imperatives. The Task Force reached the following conclusions:

- They still have the necessary political commitment for moving forward.
- They should develop a framework related to chemical accident prevention and preparedness, recognising that existing laws provide a sufficient basis for doing this.
- Given the limited number of hazardous installations in the country, the scope of the chemical accidents programme should be defined by identifying industries of concern. This will be reviewed by the MoE within three years to determine whether Country X should change the scope of the programme by developing a list of chemicals and thresholds quantities to define the covered facilities.
- The priority should be on:
  - storage facilities, which should be subject to controls specifying that the owner/operator knows the chemicals that are in storage and their properties, assesses the risks, and establishes procedures to help ensure appropriate placement of the chemicals; and
  - the port, and other transport interfaces, which should be subject to controls to ensure that information concerning cargo is maintained, to improve loading and unloading operations, and to maintain the integrity of containers.
- The pesticide manufacturer and formulator, and the refinery, should also be subject to reporting requirements and periodic inspections. However, it was noted that the owners/operators of these facilities have safety management systems in place and the resources needed to operate safely.
- The programme should include reporting requirements and a system of inspections.
- The authorities should publicise the general duty clause that already exists in their legislation.
- The programme should also contain provision for consultation, and coordination, with neighbouring countries given the location of facilities near borders and next to rivers. The UNECE Convention and related documentation could provide a model for this.
- Given the proximity of developments near hazardous installations, efforts should be made to reduce the risks of off-site effects and to educate the public at risk about the actions they should take in the event of an accident.
- Given the plan for industrial development over the next five years, land-use planning rules should be established to guide the site selection for new facilities and to avoid encroachment of housing and other development near the hazardous installations. In addition, any proposals for new or expanded hazardous installations should be subject to reporting requirements before getting construction approval.
- Efforts should be undertaken to find the resources to hire, train, and equip additional technical support staff and inspectors.

Fictitious Example – Development Phase *(continued)*

- Given the limited number of staff readily available for technical activities, a plan should be developed to identify how to implement the programme in stages, starting with the development of regulations and guidance materials and limited inspections when there is information indicating a problem might exist. Regular inspections of the most hazardous installations will be phased in as more trained staff are available.
- Inspectors' training needs to be expanded to include issues related to safety of chemical accidents.
- Response teams need to have additional training, and equipment, to adequately respond to a chemical accident.
- Given the large number of agencies involved, the chemical accidents programme should incorporate an ongoing coordinating mechanism to avoid overlaps and conflicts in the implementation of laws, regulations, and policies.
- The records concerning past accidents are insufficient. A reporting system should be established, and there should be investigations of key accidents. Efforts should also be made to learn from the experience of other countries.
- The government should hold a series of training programmes for local officials.
- Any new draft regulations and policies should be made available with an opportunity for the public to comment.

A draft strategy for moving forward was circulated to the Task Force. It set out a four-month schedule for developing the chemical accidents programme, assigning responsibilities for different aspects, creating a mechanism for consultations with public and private sector stakeholders, and establishing a schedule for meeting specified milestones.

CHOOSE/ADAPT ELEMENTS OF PROGRAMME

Armed with the conclusions of the second meeting of the Task Force and the resultant strategy, the Policy Director (PD) of the MoE and his team were responsible for developing a first draft of the chemical accidents programme. To facilitate this process, the PD used several international guidance materials including UNEP's *Flexible Framework Guidance*, the ILO Convention and supporting materials, the OECD *Guiding Principles for Chemical Accident Prevention, Preparedness and Response* (2nd ed., 2003), the Seveso II Directive and related guidance materials available on the Major Accidents Hazard Bureau website, and the materials available on the US EPA website. The team reached several decisions:

- The programme could be developed through regulations and policy statements. There is no need to create new legislation because existing laws delegate sufficient responsibility to the Ministries.
- The programme should be simple at the outset, especially in light of the limited industry in the country, recognising the programme can expand over time, as needed.
- There is no need to create a new general duty clause since it already exists, but it should be referenced in the regulations and publicised broadly.
- Owners/operators of hazardous installations subject to the regulations will be required to provide specified information to authorities within six months. In addition, notification of new installations and significant modifications will be due one year before construction is expected to start.
- Within a year, these owners/operators will be required to submit a safety report, containing basic information, with additional information upon request. While the team considered establishing a tiered system, they concluded that with just a handful of hazardous installations, they should have one tier with additional information required on a case-by-case basis following review of the safety report.
- Owners/operators will be required to undertake an assessment of risks using a recognised methodology.
- Guidance will be developed to help owners/operators to establish an accident prevention policy and to implement a safety management system.
- Owners/operators will be required to establish and maintain on-site preparedness planning.
- Owners/operators will also be required to provide the information needed by authorities to develop off-site plans.
- Owners/operators will be required to provide information to the public in the vicinity of their installation following guidance to be developed by the Ministry of the Environment.
- Any facility (including those not otherwise covered by the programme) will be required to report to the Ministry of Environment any accident that meets specified criteria. They will also be required to investigate significant accidents and to provide the investigation reports to the Ministry, with protection for confidential business information.
- Guidance related to the implementation of the programme will be developed in the two national languages.
- Land-use planning requirements will be established to site new installations at an appropriate distance from public areas and sensitive environments. This will apply to major modifications to existing installations. Existing developments will be reviewed to determine whether there is a need to remove buildings from the vicinity of hazardous installations or whether additional measures may be needed to protect people and sensitive environments. The responsibility for implementing land-use planning will be delegated to local authorities.

Fictitious Example – Development Phase *(continued)*

- Inspections will be carried out by the Ministry of Labour, with support from technical experts from other Ministries. This way, the chemical safety inspections can be coordinated with the more general labour inspections.
- Off-site preparedness planning will be delegated to local authorities. Guidance will be provided to ensure that appropriate actions are carried out. Training programmes in HAZMAT will be offered by the Ministry of Civil Defence for local authorities. Grants will be available for the purchase of equipment.
- The Ministry of Environment will have the lead in investigating accidents, in cooperation with other agencies, whenever they believe that an investigation will significantly improve prevention practices, or if they believe it is necessary for enforcement of laws.
- The government will initiate consultations with neighbouring countries that might have installations that could affect Country X in the event of an accident and with countries that might be adversely affected by an accident located in Country X.
- The allocation of responsibilities among authorities will NOT be designated in the regulation but, instead, will be delegated to the Task Force to decide. The Task Force will also consider whether any Ministries will need additional resources (including staff) to carry out its responsibilities.
- An ongoing coordination mechanism will be established by regulation.
- Contacts will be made with UNEP and WHO to see whether these organisations can provide some support for training activities.

The chemical accidents programme (including draft regulations and policy statements) will be reviewed by the Task Force and revised accordingly. Following that process, the draft will be made available for public review and comment. After three months, the Task Force will reconvene to review the comments and revise the regulation before it is finally adopted.

B5: Implementation Phase

This phase is presented in five steps, which capture the key activities that a country will have to address to implement its chemical accidents programme and thereby achieve what is intended with the programme.

At this point, it is assumed that a chemical accidents programme has been developed and is reflected in some combination of legal documents – laws, regulations, directives, orders – or other written policy instruments or programmes.

It should not be implied that the steps described below need to be taken in sequential order. In fact, many of the activities outlined in these steps are closely linked and inter-dependent. In many cases, the steps will be undertaken in parallel. Furthermore, most of the implementation activities are of a continuing nature.

Each country will need to decide how to approach the implementation phase; the work done during the assessment and development phases should provide insights on how to proceed with the implementation phase.

The five steps are:

a. **resource requirements:** identifying and maintaining the resources needed for implementation, which includes staff, budget, and equipment;
b. **information access and sharing:** determining what types of information are needed to support implementation and creating the means to collect or generate this information. This step includes developing a database of hazardous installations and provision of information to the public;
c. **administrative and legal structures:** ensuring appropriate structures are in place, and responsibilities are assigned, for each aspect of the programme;
d. **leadership:** inspiring and facilitating implementation by industry and others with roles in chemical accident prevention and preparedness; and
e. **enforcement:** creating means for identifying non-compliance, including monitoring and inspection programmes, and imposing appropriate sanctions for non-compliance.

"Implementation" is used here to include a wide range of activities involved in putting the elements of the programme into practice. This *Guidance* focuses on the role of government bodies in implementing a chemical accidents programme including their role in facilitating the implementation of others by, for example, providing guidance.[19]

To be effective, each country should adapt its implementation activities to its specific context, taking into account its legal and cultural context, the nature and extent of risks, resources available, etc. In addition, the objectives of each element of the programme need to be kept in mind so that the implementation activities are directed to meeting these objectives.

The lists of activities outlined in the five steps described below may appear difficult to achieve. But these lists are provided to help guide decision-making and are not meant to be a checklist of everything that has to be done at once. While some of the activities are key, each country needs to decide which activities are most important and adapt them to local circumstances. Furthermore, these activities can be undertaken in stages, over time.

Thus, part of this process is to identify priorities and to consider the best order for moving forward.

The reality, in most countries, is that there are not sufficient staff or other resources to do all that is intended. The goal should be to set realistic goals and, at the same time, ensure that enough resources are available for a meaningful implementation of the programme, even if it is limited at the outset.

a. Resource Requirements

To move forward with implementation, the first step is to develop a plan which identifies the resources needed to implement the various aspects of the newly developed chemical accident programme, and how these needs might be met and maintained over time (*e.g.*, staff, budget,

[19]It is understood that the enterprises have the primary responsibility for the safety of their hazardous installations. Owners/managers should ensure that all enterprises have a safety culture that promotes the attitude that safety is a priority, as well as a safety management system (including appropriate organisation, technology, procedures) that minimises risks related to chemical accidents. Additional information is provided in Text Box 2 (Roles of Stakeholders) on page 11, Text Box 12 (Safety Management Systems) on page 95, SG-1 (Guidance on Safety Management Systems) on page 117, and Annex VI (Selected Bibliography) on page 170 for sources of guidance concerning industry's role in accident prevention and preparedness.

technology, equipment). Information, a key resource, is addressed separately below.

It is important to consider how to best make use of the staff that are available even if the identified needs are not fully met. This can be done, through, for example, on-the-job training and mentoring programmes, and sharing of experience. In addition, consideration can be given to what actions should be taken over the short term and what can be phased in. Furthermore, countries should take into account how to minimise duplication of effort.

It may be necessary to decide which activities take precedence and to re-assess priorities. For example, if it is not possible to sufficiently staff the inspections programme, there may be a need to decide whether to change the frequency or targets of the inspections. If there are more funds made available than had been expected, then there may be a need to decide how to expand the programme or which activities might most benefit from additional resources.

Implementation Phase: Resource Requirements GOAL and ACTIVITIES

GOAL:

To identify, and then secure, the resources needed to effectively implement the chemical accidents programme. Resources include staff, budget, and equipment/technology (information is addressed in the next step).

SUGGESTED ACTIVITIES:

Staff:

- Identify the numbers and types of staff that are needed in light of roles identified in the chemical accidents programme, and the nature and extent of risks.
- Assign or hire staff (or, as necessary, use consultants) to meet these needs.
- Establish and maintain an appropriate staff training programme.

Budget:

- Prepare a realistic budget for carrying out assigned responsibilities.
- Review options for securing the funds.

Technology, equipment, etc.:

- Identify the technology, equipment and other resources needed (in addition to staff, financing, and information).
- Determine where and how these resources can be accessed, as needed.

Countries should also consider what non-governmental resources might be available from within the country, as well as from external sources. For example, there may be assistance available through bilateral assistance programmes or from various UN bodies and other international organisations.

Text Box 5 (Resources Used in the Implementation of a Chemical Accidents Programme) on page 49 contains an excerpt from the ILO Code of Practice on Prevention of Major Accidents describing the type of resources that are ideally involved in the implementation of a chemical accidents programme. It may be helpful to use this text when reviewing resource needs. It is not expected that a country, when establishing its programme, will be able to access the full range of resources described in Text Box 5.

Staff: Government bodies should strive to have sufficient numbers of qualified staff available to carry out their roles and responsibilities, as established in the chemical accidents programme. The objective should be to have staff with the right mix of expertise, knowledge, and experience, and be adequately educated (*i.e.*, they have the necessary knowledge, background, and skills) and trained for their jobs.

A profile of what expertise is available, and what gaps exist, will help in developing a strategy to address staffing needs.

Staff requirements will include individuals with scientific and technical expertise to be able to carry out the tasks needed to implement the programme, for example, to prepare regulations and guidance materials, to review safety reports, to carry out inspections, and to understand how hazardous chemicals might impact human health and the environment. In addition, legal expertise may be needed for regulatory and enforcement activities and medical staff for emergency preparedness and response efforts.

This staff may consist of new hires or existing staff allocated new responsibilities. In some cases, specific assignments may be given to temporary employees or external consultants.

Hiring can be done in stages, in connection with a phased implementation of the programme. For example, it is not possible to undertake inspections and other enforcement-related activities until there are competent staff in place, which involves a combination of hiring, training and, perhaps, contracting with experts. On the other hand, it is possible to create an inspection team in phases with the first hires focusing on the highest-priority installations. The inspection programme can be expanded as staff become available and trained.

Training is important to help ensure that staff members are generally familiar with the chemical accidents programme, as well as have an understanding of their specific roles and responsibilities and related laws, regulations, and policies.

The goal should be to train staff members when they take on new responsibilities and periodically thereafter to help ensure continuing competence. Training programmes should be regularly reviewed and updated to be sure they are achieving their desired results.

Countries should consider how they might be able to undertake training activities. It need not be done in-house. For example, industry might be called on to help provide some of the technical and scientific training, or local universities or non-governmental organisations could be engaged. Furthermore, there are materials available from international organisations and other resources to support training activities. Neighbouring countries might consider having joint training programmes, for example, to share experience with respect to inspections or accident investigations.

Retaining qualified staff is an issue faced by most countries. To help with this, management should provide adequate support and resources to their staff and establish procedures for staff members to give and receive feedback. Staff members should receive appropriate acknowledgement for doing their job well.

Budget: It is critical to analyse what financial resources would be needed for implementing the chemical accidents programme and to set priorities for action based on the resources that can be made available. All organisations have resource constraints and, therefore, priority-setting is needed to make the most effective allocation of limited resources.

The budget should take account of all related costs such as staff salaries, consultants' fees, and training as well as expenses associated with, for example, outreach and communication activities, information and database management, transportation, enforcement activities (including inspections), emergency preparedness, and accident investigations and follow-up.

Through collaboration, government bodies may be able to improve efficiency, avoid overlaps, and share responsibilities, thereby reducing the overall budgetary needs. For example, it may be possible for chemical safety inspections to be carried out jointly with labour inspections and thereby reduce the need for multiple inspections of a hazardous installation.

There are different mechanisms that have been used to generate funding for chemical accidents programmes. Each country should consider what is best in its circumstances. These could include some combination of:

- allocations from general budgets;
- sharing costs through multi-agency contributions;
- fines (sanctions for non-compliance);
- taxes on certain chemicals or on wastes;
- permits fees (*e.g.*, for licences to operate); and
- fees for services (*e.g.*, for inspections, training, laboratory use).

Equipment and Other Resources: This category addresses equipment, technology, and other materials needed to implement a chemical accidents programme. This could include, for example: computer hardware and software needed to manage databases and other information and to create a website; transportation and personal protective equipment for inspectors to visit facilities; and medical supplies and specialised response and decontamination equipment as identified in emergency preparedness plans.

Some types of equipment might be needed on a periodic basis and, therefore, could be shared among organisations within the country or across borders, or could be purchased on as as-needed basis rather than being kept in inventory. As an example, as part of their preparedness planning, governments can agree to share HAZMAT equipment among neighbouring communities.

Text Box 5

RESOURCES USED IN THE IMPLEMENTATION OF A CHEMICAL ACCIDENTS PROGRAMME (ILO Code of Practice on Prevention of Major Accidents)

Chapter 4 of the ILO Code of Practice, set out below, describes the types of resources involved with the development and implementation of a chemical accidents programme including expertise, equipment, and information. This list represents what would ideally be available to a country. In practice, all countries face resource limitations. This list can be a valuable tool to help countries identify what is available and what may be needed in their circumstances. It might also help to determine how to move forward with a phased approach to implementation.

4.1. General

4.1.1. The prerequisites for the operation of a major hazard control system are:

a. manpower, within industry as well as within the competent authorities, including external expertise if necessary;
b. equipment;
c. information sources.

4.2. Manpower requirements

4.2.1. General

4.2.1.1. Works management should ensure that it has an adequate number of workers available with sufficient expertise before operating a major hazard installation. The design of jobs and systems of working hours should be arranged so as not to increase the risk of accidents.

4.2.1.2. For a fully operational major hazard control system, competent authorities should ensure the availability of the following specialised manpower:

a. government inspectors with specialist support;
b. specialists on hazard and risk assessment;
c. specialists on examination and testing of pressure vessels;
d. emergency planners;
e. experts on land-use planning;
f. emergency services, police, fire authorities, and medical services.

4.2.1.3. Competent authorities should not wait for the availability of specialised manpower in all fields before starting a major hazard control system. They should set realistic priorities based on available manpower.

4.2.2. Government inspectorate

4.2.2.1. Competent authorities should make available suitable staff, including specialist support for inspection of major hazard installations, and provide them with suitable training in their duties.

4.2.3. Group of Experts

4.2.3.1. Competent authorities should make resources available to establish a Group of Experts in the country, particularly when there is a shortage of technical expertise within the existing factory inspectorate. This Group should include experienced engineers and scientists.

4.2.3.2. If appropriate, this Group should be seconded from outside the competent authorities, such as from industry, trade unions, or specialised consultancies.

4.2.4. Advisory committee

4.2.4.1. Competent authorities should consider the establishment of an advisory committee on major hazards. This committee should include representatives from all organisations involved or experienced in major hazard control, including:

a. competent authorities;
b. works managements and employers' organisations;
c. trade unions or workers' representatives;
d. local authorities;
e. scientific institutions.

4.2.4.2. The objectives of this committee should include:

a. discussion of priorities for the major hazard control system in the country in accordance with any national requirements;
b. discussion of technical matters with respect to the implementation of the major hazard control system;
c. making recommendations on all aspects of the safety of major hazard installations.

Text Box 5 *(continued)*

4.3. Equipment

4.3.1. Competent authorities should consider whether elements of the major hazard control system require the use of computer systems, particularly in establishing data banks and national or state inventories of major hazard installations.

4.3.2. Depending on local arrangements, works management, or local authorities should make available technical equipment, for use in an emergency situation, in accordance with the needs of the emergency plans. Such equipment should include:

a. first-aid and rescue material;
b. fire-fighting equipment;
c. spill containment and control equipment;
d. personal protective equipment for rescue personnel;
e. measuring instruments for various toxic materials;
f. antidotes for the treatment of people affected by toxic substances.

4.4. Sources of information

4.4.1. Competent authorities should determine their information needs for establishing a major hazard control system. These may include:

a. technological developments in the process industries;
b. developments in major hazard control;
c. codes of practice of safety-related technical issues;
d. accident reports, evaluation studies, and lessons learned;
e. inventory of experts and specialists on major hazard control.

4.4.2. Competent authorities should consider appropriate sources for this information, which may include:

a. industry experts and researchers;
b. industry and trade organisations;
c. national and international standard-setting organisations;
d. trade union organisations;
e. consultants;
f. universities, colleges, and research institutes;
g. professional institutions;
h. international codes of practice and guiding principles;
i. national codes and regulations of highly industrialised countries;
j. reports of accidents;
k. published reports about major hazard assessments;
l. proceedings of seminars and conferences;
m. specific textbooks;
n. publications and articles in journals dealing with major hazards.

b. Information Access and Sharing

Information is a critical component of successful implementation of any chemical accidents programme.

There are many types of information needed including, for example: a dictionary/thesaurus of the local names of hazardous chemicals; information on the characteristics of hazardous chemicals (such as how they react when released and their potential adverse effects in the event of an accident); risk assessment methodologies; first aid measures; locations of hazardous installations; and accident reports.

Much of this is available from existing sources and, therefore, just needs to be collected and organised.

The regulated industry should be able to provide information about their specific activities.

Through the internet, it is possible to get access to a great deal of information from international sources to support the chemical accidents programme, such as information on risk assessment methodologies, chemical characteristics, health impacts, and treatment for poisoning.

Information about chemicals of concern and their potential impacts in the event of an accident is available from countries that have had chemical accident programmes in place as well as from international organisations.

Universities and research institutions also have publicly-available information about chemicals.

Some of this information may only be available in a limited number of languages and, therefore, may need to be translated for local use.

Each country should establish databases specific to their situation including:

- an inventory of hazardous installations subject to the chemical accidents programme, along with relevant information about each installation; and
- an accident reporting mechanism that will allow for information on chemical accidents to be collected, stored, and accessed.

The inventory of installations can be created from information gathered from the assessment phase, and supplemented by information provided directly from industry (*e.g.*, from notifications, safety reports, and accident reports) and from inspections.

This inventory can help inform decisions on how to allocate available resources for implementation and enforcement (including inspections). It can also support preparedness planning.

Implementation Phase: Information Access and Sharing GOAL and ACTIVITIES

GOAL:

To ensure the information needed for effective implementation of the chemical accidents programme is available and to develop mechanisms to share information with other stakeholders.

SUGGESTED ACTIVITIES:

- Categorise the types of information needed for the chemical accidents programme.
- Identify sources of information.
- Systematically collect and record information.
- Establish an inventory of hazardous installations.
- Establish administrative structures, databases, and other mechanisms to facilitate the collection, review, maintenance, and updating of information from notifications and safety reports.
- Establish an accidents reporting scheme.
- Establish a mechanism for sharing information among the government bodies involved with the chemical accidents programme.
- Create procedures for sharing information, and consultation, with all stakeholders including industry, workers, the public, and non-governmental organisations.
- Ensure effective provision of information to the potentially affected public.
- Establish mechanisms for the exchange of information within the country and between countries.
- Promote exchange of experience and lessons learned.

With respect to accident reporting, there should be clear criteria concerning which accidents must be reported to the authorities and which should be subject to investigations by the industry and/or authorities. The accident reporting scheme is very valuable for learning lessons to reduce the likelihood of future accidents, as well as to inform decisionmaking about priorities and planning of inspections and other enforcement activities. It also provides one way of measuring the success of prevention and preparedness planning activities.

Promoting Effective Information Sharing: As emphasized above, cooperation among government bodies, as well as between authorities and other stakeholders, is critical for efficient and effective implementation of a chemical accidents programme.

Chemical accident prevention and preparedness is, by nature, an interdisciplinary activity involving a number of government bodies at local, regional, and national levels. Whenever there is more than one government body involved, the relevant government bodies should coordinate their activities and share information. This will maximise efficiency of available resources as well as improve the overall effectiveness of the chemical accidents programme. In so doing, regulations, guidance, and policies can be complementary, not duplicative or contradictory. Such cooperation also allows for an efficient use of scarce resources, and provides the basis for learning from each others' experiences.

c. Legal and Administrative Structures

Appropriate legal, administrative, and consultative structures need to be in place in order to implement and enforce each aspect of the chemical accidents programme. These structures should be consistent with existing systems and take into account local culture and political/ regulatory processes.

Implementation Phase:
Legal and Administrative Structures
GOAL and ACTIVITIES

GOAL:
To put into place the legal and administrative structures necessary to implement the chemical accidents programme.

SUGGESTED ACTIVITIES:

- Consider which bodies (ministries, agencies, etc.) are best placed to implement each element of the programme (it may be more than one).
- Clarify how coordination will be maintained and who has the lead for each element.

The term "structures" is used here to refer to the different bodies that might be involved. Depending on local circumstances, this could include ministries, agencies, departments, bureaus, or offices. It could also involve a task force or other mechanism which calls on the resources of more than one body. It could involve an affiliation among individuals employed by different bodies or could entail the contracting of certain activities to consultants or non-governmental organisations.

There are many examples of the different ways of allocating staff and resources in a way to carry out the objectives of the programme. It could consist of one office designated as having the lead authority for implementing all or part of the programme. In most cases, the roles and responsibilities will be spread among different authorities. As an example, the Ministry of the Environment might handle the notifications, but contract the local university to review and analyse safety reports, work in conjunction with the Ministry of Labour to carry out inspections, and work with the Ministry of Justice for enforcement activities. Some roles, such as land-use planning, may be allocated to local or regional agencies.

Thus, it is not necessary to establish new bodies to implement the chemical accidents programme; existing structures may be used for these purposes or a combination of the two. It may be that the legal and administrative structures will be phased in over a period of time as staff are hired and trained.

In considering the legal and administrative structures, it is useful to consider that:

- the approach chosen should be consistent with the country's legal and cultural context and experience;
- the process of adapting existing structures, or creating new ones, should be transparent and well-publicised;
- each element of the programme should be considered and it should be clear which authority(ies) has the lead for implementation and enforcement;
- systems should be in place for coordination and consultation among authorities; and
- whatever approach is chosen, it should be reviewed periodically and changed, as needed, to best meet the objective of the programme.

d. Leadership: Facilitating Implementation by Industry and Others

Government bodies should motivate other stakeholders to recognise the importance of chemical safety, and to fulfil their roles and responsibilities related to chemical accident prevention and preparedness. The government should cooperate with owners/managers and with workers to facilitate the safe operation of hazardous installations and to ensure that appropriate information is provided to the public.

The role of government in providing leadership is summarised in Text Box 6 (Providing Leadership) on page 54.

Government bodies should develop outreach programmes to provide information to and get feedback from industry, the public, and others about chemical accident prevention and preparedness. These outreach programmes should be carefully designed taking into account local circumstances and the target audiences.

Relationship with Industry: There should be ongoing cooperation between government officials and industry, based on a policy of openness, which includes frequent dialogues and information exchanges, and proactive approaches concerning the safety of hazardous installations and accident prevention. This type of cooperation will help increase public confidence that appropriate measures are being taken to limit the risks from hazardous substances.

The government should publicise its laws, regulations, and policies so that industry is aware of its obligations and of the resources available to facilitate implementation.

The government should provide clear, easy-to-understand guidance on how objectives and requirements can be met by industry. This includes guidance for preventing accidents, as well as for preparedness planning.

Implementation Phase: Leadership GOAL and ACTIVITIES

GOAL:

To improve public understanding of the risks of chemical accidents, and to motivate industry and others to take appropriate actions to prevent such accidents and to prepare adequately for any accidents that might occur.

SUGGESTED ACTIVITIES:

- Establish an outreach programme to inform industries and others about chemical accident prevention and preparedness, as well as their roles and responsibilities under the chemical accidents programme.
- Create mechanisms to facilitate improved accident prevention and preparedness including training programmes, guidance materials, websites, etc.
- Develop a schedule for implementation by industry that allows industry an appropriate amount of time to comply with any requirements.
- Ensure that the public has information about hazardous installations and what actions to take in the event of an accident.
- Provide opportunities for public participation.
- Maintain ongoing cooperation with stakeholders.
- Promote sharing of experience.

This guidance can be prepared in cooperation with industry. It can build on materials available from international organisations (such as UNEP, ILO, WHO, and OECD) and from other countries, all of which are generally posted on websites. Using the available materials, country-specific guidance can be developed in the local languages and dialects, using appropriate terminology and taking into account the cultural context.

Government authorities should try to stimulate industry to use improved safety technology and safety practices, and not merely try to meet any requirements. Requirements should be considered the minimum to be done; industry should be encouraged to achieve a higher level of safety than would be achieved by adherence to established standards.

One way to promote improved safety is to allow industry some flexibility in the methods used to meet the requirements and policies, so that an enterprise can use the methods best-suited to its particular circumstances.

Government should also promote sharing of experience among companies related to safety management systems, accident experience, lessons learned from accidents and investigations, and other matters that will improve safety. Sharing information on past accidents and lessons learned is key to avoiding similar accidents in the future and for improving response capabilities.

There are a number of ways to encourage learning from experience. For example, authorities can: establish a user-friendly website; convene meetings/workshops of companies facing similar risks; circulate periodic newsletters highlighting keys to safety and causes of accidents; disseminate accident investigation reports; translate and summarise relevant reports from other countries; provide technical assistance to companies; and encourage product stewardship and the mentoring of smaller companies by larger ones.

Relationship with the Public and Other Stakeholders: Government should also cooperate with all relevant stakeholders that have important roles in helping to improve safety at hazardous installations.

Cooperating with stakeholders helps to ensure useful information and guidance is provided to industry and the public, and helps to avoid redundancy and conflicting messages. It also gives the public and other stakeholders confidence that chemical risks are being addressed.

All stakeholders need information to help them in carrying out their roles and responsibilities. In addition to industry and workers, these stakeholders include industry associations, trade unions, environmental groups, universities and research institutes, local authorities, community-based groups/communities, and other non-governmental organisations.

Government bodies have a special role in facilitating education of the public so that people understand the risks they face, know where to obtain information concerning hazardous installations in their communities, are reassured that safety measures are in place, know what to do in the event of an accident, and can effectively participate in relevant decision-making processes.

Public awareness is likely to lead to a reduction in the number and severity of chemical accidents. An informed public can provide an incentive for industry to reduce the risks of chemical accidents. In addition, an informed public can provide a stimulus for dialogue among industry, government bodies, and the public, and a basis for effective participation of the public in decision-making related to hazardous installations.

Providing information to the public may sound straightforward but, in fact, requires planning so that the information schemes are appropriate to their targets, are repeated and tested, and are updated as appropriate.

Non-governmental organisations are often in a unique position to assist in disseminating objective chemical information to the public. They can also work with industry to help develop innovative ways to improve safety as well as help to monitor the performance of government authorities and identify concerns about the chemical accidents programme and its implementation.

The government should provide opportunities for the public and other stakeholder groups to participate in appropriate decision-making processes (such as land-use planning and licensing decisions). For these opportunities to be meaningful, there needs to be adequate notice and access to the information needed for effective participation.

Text Box 6

PROVIDING LEADERSHIP

Perhaps the most important role of government is to provide leadership, to create a culture that promotes safety and motivates all stakeholders to recognise the importance of accident prevention and preparedness, and to fulfil their respective roles and responsibilities.

Leadership is demonstrated in a number of ways including taking actions that indicate the government is serious about addressing chemical safety. The combination of activities that will convince constituents that their government is serious about improving accident prevention and preparedness is dependent on cultural and other local factors but would generally involve a combination of:

- transparent government decision-making, with input from different stakeholder groups;
- allocation of resources including competent staff to implement a chemical accidents programme;
- implementation of the programme in a fair and equitable way;
- development and distribution of information and guidance that is appropriate to the target groups;
- timely response to identified problems or concerns; and
- improving safety of government-owned or operated facilities.

Education and awareness-raising among all sectors of society is critical. The government need not do all the outreach and information-sharing itself but should seek to ensure that appropriate information is provided to, and received by, all relevant stakeholders.

Government should also provide opportunities for the public and other stakeholder groups to participate in appropriate decision-making processes.

e. Enforcement

Enforcement of the requirements established in the chemical accidents programme is critical to achieving the objectives of the programme. Government bodies must be prepared to enforce requirements and adequate resources should be made available for monitoring, inspections, and other enforcement-related activities. A strong enforcement policy not only helps to ensure industry will be in compliance, it also builds trust with the public.

There should be clear and suitable sanctions applicable in the event of non-compliance. This can include civil and, in extreme cases, criminal sanctions. There are a number of different types of civil sanctions available, depending on the severity of the concerns, including for example, notifications, agreement on actions to be taken with timetables, citations, fines, and, in the most severe cases, shutdown of facilities.

Governments should make sure that guidance is available so that anyone subject to the chemical accidents programme knows how to fulfil their obligations. This guidance should reflect the common understanding of what constitutes a violation.

Implementation Phase: Enforcement GOAL and ACTIVITIES

GOAL:

To ensure that all enterprises meet legal requirements related to chemical accident prevention and preparedness, that they operate their installations to minimise risks of a chemical accident, and that they are adequately prepared should an accident occur.

SUGGESTED ACTIVITIES:

- Identify appropriate sanctions for non-compliance with requirements (to the extent this is not already established in legal instruments).
- Establish enforcement procedures and implement these procedures as appropriate (including prosecution for significant non-compliance).
- Review safety reports and other submissions by hazardous installations for information about compliance, and to support inspection activities.
- Establish procedures for undertaking inspections that are appropriate for the nature and extent of risks in the country.
- Create common protocols and guidance to ensure the ability to compare different inspections.
- Establish a strategy for maintaining inspector competency and learning from experience.
- Establish mechanisms to ensure recommendations and remedial actions identified in inspection reports are carried out.
- Coordinate and share experience among relevant organisations (to minimise duplicative efforts, reduce burden on industry, and learn from others' experience).

Enforcement should be applied fairly and uniformly, whether the hazardous installation is owned by a domestic or foreign company, and whether it is publicly or privately owned.

Enforcement activities should complement other activities by government bodies to ensure that industry complies with all appropriate laws and regulations (*e.g.*, incentive programmes, technical assistance, outreach, etc.).

There are a number of ways to check whether a hazardous installation is meeting the relevant legal requirements. For example, inspections provide an opportunity for government officials to view firsthand the operation of the installation and to ask questions of management and staff. In addition, a review of a safety report can provide insights into whether the installation is operating in a manner consistent with legal and policy instruments, and whether there is an adequate safety management system in place. The safety report also provides critical background information to support inspections.

Creating Monitoring and Inspection Programmes: An inspection programme carried out by, or on behalf of, the government is a critical enforcement tool for chemical accident programmes.

Inspections serve a number of purposes. The primary objectives of inspections are to determine whether hazardous installations are complying with relevant regulations, standards, and practices, and whether safety management systems are in place and operating appropriately. The inspection also allows government bodies to check the validity of safety reports.

Inspections can also be used to help enterprises identify potential problems (even if they are not subject to legal requirements). Inspectors should also use the opportunity to share experience and provide advice.

It needs to be clear that the involvement of government in monitoring, including inspections, does not diminish the fact that the primary responsibility for the safety of hazardous installations rests with the management.

Additional information about inspection programmes and, in particular, key aspects of successful inspections, is provided in Chapter C, Section C3, part (c) (Inspections) on page 71.

B6: Review and Revision Phase

A chemical accidents programme – its regulations, policies, and practices – should be reviewed periodically to see whether it is operating as intended, meeting its objectives, and making best use of the available resources. The review will allow authorities to determine whether there should be a shift in priorities and whether the programme should be expanded or otherwise amended in light of any changes in the level or nature of risk, availability of resources, experience gained, and/or other factors.

Review and Revision Phase GOAL and ACTIVITIES

GOAL:

To implement a system for the periodic review of the chemical accidents programme to test whether it is operating as intended and to revise the programme, as appropriate.

SUGGESTED ACTIVITIES:

- Establish a process for reviewing the effectiveness of key elements of the chemical accidents programme (using performance indicators).
- Consult with other stakeholders to get feedback on the chemical accidents programme.
- Make changes to the programme's activities and priorities in light of experience, changes in priorities, technical progress, and other new information.

The review should take into account a number of factors including:

- experience gained by the government, as well as industry and other stakeholders;
- significant changes in the number or types of hazardous installations;
- accident case histories and lessons learned from within the country or from other countries;
- the resources that are available and those that are likely to be available in the near future; and
- changes in technology and safety procedures.

Support for such a review can be found in the OECD *Guidance on Developing Safety Performance Indicators for Public Authorities and Communities/Public* (2nd ed., 2008).

Chapter C:
ELEMENTS OF A CHEMICAL ACCIDENTS PROGRAMME

C1: Introduction

Set out below are the elements that are generally contained in a comprehensive programme for chemical accident prevention and preparedness. These elements have been derived from international agreements,[20] the Seveso II Directive from the European Union,[21] and the various laws and regulations adopted by the US,[22] as well as decades of experience by various countries in implementing relevant laws, policies, and agreements.[23]

The elements are organised into five parts:

i. The scope of the programme, which establishes what types of industries, facilities, and/or substances are addressed by the programme.

ii. The role of the competent authorities, which establishes the types of activities which are generally carried out by identified government bodies.

iii. The requirements of industry, which establishes the types of requirements generally imposed on industry (or which industry undertakes in order to meet a general obligation to operate their installations safely). In this context, the installations could be either privately or publicly owned.

iv. Information to the public, which describes the types of information that should be provided to those potentially effected in the event of an accident. The responsibility for carrying out the information dissemination should be identified and usually involves a joint effort between authorities and industry, in cooperation with other stakeholders.

v. Accident reporting, investigation, and follow-up, which describes the activities providing a means to learn from accidents and share lessons to improve safety. The programme will generally have criteria to identify which accidents are subject to reporting and investigation requirements, although voluntary reporting and investigation of "lesser accidents" should be encouraged to promote learning from experience.

The five parts are used as a means for organising the elements for the purpose of this *Guidance*. A summary of the key elements of each of the five parts is shown on Table V (Elements of a Chemical Accident Prevention and Preparedness Programme) on page 60. However, this does not reflect how each element is implemented in practice and each country can decide how best to organise its laws, regulations, policies, programmes, and other instruments.

Many, if not most, of the elements described in this *Guidance* involve a need for cooperation and communication between stakeholders. For example, included within "Requirements of Industry" are the elements entitled "Notification" and "Safety Reports." Both of these would require enterprises covered by the chemical accidents programme to provide information to authorities. These authorities would need to have systems in place to collect and use the information. In addition, "General Duty Clause" (GDC) is included within the "Requirements of Industry;" however, a GDC can be defined in some countries to also involve the duty of authorities.

Most countries with significant chemical industries, or other hazardous installations, have legal and policy instruments addressing most, if not all, of the elements outlined in this Chapter.

---

[20]Notably the ILO Convention concerning the Prevention of Major Industrial Accidents (C174) and the UNECE Convention on Transboundary Effects of Industrial Accidents.

[21]Council Directive 96/82/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances, extended by the Directive 2003/105/EC of the European Parliament and of the Council of 16 December 2003 amending Council Directive 96/82/EC. See: http://ec.europa.eu/environment/seveso/legislation.htm.

[22]These include:
- the Risk Management Plan (RMP) Program: Section 112(r) of the amended Clean Air Act, with its regulations (40 CFR Part 68);
- Emergency Planning & Community Right-to-Know (EPCRA): 42 U.S.C. 116, with its regulations (*e.g.,* 40 CFR 355, 40 CFR 370).

[23]Excerpts from relevant sections of these agreements and regulations are provided throughout the Chapter.

Developing countries may not be in a position to implement and enforce a comprehensive chemical accidents programme. This Chapter has been designed to help a country identify which elements may be appropriate in its specific circumstances. The goal is to establish a programme that is in proportion to the level of risks in a country, taking into account the country's risks, availability of resources, political imperatives, and local customs.

Furthermore, a country should consider how it can most effectively build its chemical accidents programme, developing it in stages, focusing first on the highest priority concerns with additional elements (and/or larger scope) added as resources and experience allow.

TABLE V:
Elements of a Chemical Accident Prevention and Preparedness Programme

The Scope of the Programme	
Scope	Under the "Scope," information related to the definition of types of industries, facilities, and/or substances covered by a chemical accident prevention and preparedness programme is provided.
The Role of Competent Authorities	
Information Management	Under the "Role of Competent Authorities," information is provided in relation to activities generally carried out by identified government bodies.
Inspections	
Preparedness Planning	
Siting and Land-Use Planning	
Requirements of Industry	
General Duty Clause	Under the "Requirements of Industry," types of requirements generally imposed on industry or undertaken by industry to meet an obligation to operate their installations safely are specified.
Notification	
Prevention Policy and Safety Management Systems	
Hazard Identification and Risk Assessment	
Safety Reports	
Preparedness Planning	
Information to the Public	
Information to the Public	This section describes the types of information that should be provided to those potentially affected in the event of an accident.
Accident Reporting, Investigation, and Follow-up	
Accident Reporting, Investigation, and Follow-up	This section provides information on accident reporting and investigations which could be pursued in order to learn and share lessons to improve safety.

C2: Scope of the Programme

Goal

Determine criteria for inclusion of a hazardous installation within the scope of the chemical accidents programme (including definitions of key terms).

Why

This is a necessary element in order to identify which installations/chemicals are subject to any requirements or policies established by a chemical accidents programme. It serves to classify which activities and which hazardous substances are of concern.

The statement of the scope should be unambiguous to avoid confusion about whether an enterprise needs to take specified actions, and to provide guidance for implementation and enforcement.

In establishing the scope, it is helpful to keep in mind the number of installations that will be captured by any determination of scope, and the resources that are available for implementation and enforcement. Care needs to be taken in deciding on the scope – too broad a scope may result in imposing unnecessary obligations on enterprises that are not posing any significant risks and may be more than can be handled with available resources (taking focus away from the most critical risks), and too narrow a scope may result in missing key installations.

Looking at what has been done in other countries, and in international instruments, can be instructive for setting the scope of a programme. But it is important that the scope be appropriate for the country given the risks and resources available.

How

The identification of scope of chemical accidents programmes generally has four primary elements:

1. **Definitions of key terms** (*e.g.*, installation, operator, accident, hazardous substances).
2. **Identification of the activities** or types of hazardous installations that will be included within the scope of the programme. For many countries, their programme has unlimited application except for specified exclusions. This is combined with the substances of concern and their thresholds to focus on the installations posing the greatest risks.

   Some countries, especially those with limited industry and/or limited resources, may decide to focus their efforts on specified sectors or industries, or a specific type of process (*e.g.*, refineries, pesticide warehouses). Others may decide to limit the scope of their programme to specific facilities or geographic areas.
3. **Identification of the hazardous substances** of concern, combined with the threshold quantities which need to be present at an installation to be subject to the requirements of the programme. In defining the scope by a list of chemicals/thresholds, the result is that all installations which have quantities of the identified chemicals (or groups of chemicals) over the specified quantity (threshold) are subject to certain requirements and policies. In some countries, there are different "tiers" of requirements based on different threshold quantities (*i.e.*, different reporting requirements for different levels of risk).

   Further discussion of this subject continues below. Additional information is provided in Text Box 8 (Alternative Approaches for Specifying the Scope of a Chemical Accidents Programme) on page 64, which describes different options for identifying the hazardous substances of concern. In addition, Annex III (Lists of Chemicals of Concern) on page 143 contains the lists of chemicals from the Seveso II Directive and the US. These two laws are used as examples throughout this text. Annex III also contains the Swiss concept to define thresholds and Korean list of chemicals to illustrate how other countries address the question of scope, with Korea focusing on a more limited group of chemicals.
4. **Exclusions** clearly identifying which types or classes of installations are not subject to the chemical accidents programme. For example, in some cases countries specifically exclude transportation, nuclear facilities, and military installations.

In deciding which chemicals to include on the list developed pursuant to element 3 (Identification of the hazardous substances) on the previous page, it is useful to consider not just their inherent characteristics, but also other relevant factors such as the context in which they are used or handled, accident history, severity of potential impacts, and available control measures. For example, some hazardous substances are used in high volumes but in well-controlled processes, leading to the reasonable conclusion that there should be higher threshold limits as compared with substances in the same hazard class which might be subject to lower thresholds (*e.g.*, LPG is often regulated at a higher threshold than other flammable gases).

Establishing appropriate thresholds helps to ensure that the programme captures the hazardous installations that pose real risks but is not too broad (establishing obligations on installations that do not pose significant risks). In setting the thresholds, typical starting points include the volumes in which substances are stored or handled (*e.g.*, drum container size) and the minimum quantity of a substance necessary for generating a certain serious effect.

The scope of the chemical accident programme generally includes classes of chemicals (toxic, explosive, flammable, reactive, or hazardous to the environment), which can be supplemented with specific chemicals. There are several reasons for identifying individual chemicals in addition to the classes of chemicals. For example, it may be that the threshold quantity for the individual chemical is different than other chemicals in that class for scientific, economic, or political reasons.

As indicated in Chapter B, the chemicals included in the programme scope and their thresholds may be influenced by political and pragmatic considerations, in addition to scientific reasons. For example, if a chemical was the source of a recent or well-known accident, there may be pressure to include it in the programme even if by objective measures it should not be high priority.

To develop its own list of chemicals with associated thresholds to be included in the programme scope, it could be useful for a country to convene a group of experts to review technical information about the chemicals that are produced, used, or stored in the country and consider their potential for causing significant accidents.

In addition to deciding on the criteria for inclusion in the programme, another issue related to scope is to decide whether the focus is on an entire site or individual operations or installations. The latter might result in several regulated installations within one site. For example, a refinery will be made up of a number of operations of concern such as storage tanks for flammable liquids, tanks for flammable gases, refining units, and storage of toxic gases. A chemical facility may have tanks and storage for raw materials, several reactors for processing the chemicals, and an end product warehouse. In each case the site contains several installations, each of which could be separately regulated or the site can be regulated as one unit.

There are advantages and disadvantages of either approach (focus on entire site, or on individual operations). For most countries, it might be easier to consider entire sites as one regulated entity to avoid having to decide on boundaries between different installations (*e.g.*, it can be difficult to determine whether a storage facility is part of, or separate from, the production facility).

Pitfalls

The identification of the scope of the programme is a critical element and care should be taken to identify the activities, substances, and thresholds so that the installations of concern in the context of the country are covered (including hazardous installations that may be built in the future), but that the scope is not so broad that the programme is impossible to administer or enforce.

The advantages and disadvantages of different approaches to identifying the installations to be covered by the programme are outlined in Text Box 8 (Alternative Approaches for Specifying the Scope of a Chemical Accidents Programme) on page 64. For example, one pitfall of using a list of specific chemicals, rather than classes of chemicals, is that it is possible that a chemical that is not included in the list inadvertently creates a significant hazard and therefore unintentionally escapes regulation.

Text Box 7 (Globally Harmonized System (GHS) of Classification and Labelling of Chemicals) on page 63 provides some information on the "Globally Harmonised System of Classification and Labelling of Chemicals." This system, developed as a cooperative effort of a number of inter-governmental organisations, could help countries identify chemicals of particular concern.

Text Box 7

GLOBALLY HARMONIZED SYSTEM (GHS) OF CLASSIFICATION AND LABELLING OF CHEMICALS

The **Globally Harmonized System (GHS) of Classification and Labelling of Chemicals** can provide useful insights for identifying chemicals of concern even though it was not specifically developed for purposes of chemical accident prevention and preparedness. Therefore, care is needed to determine how the GHS might be adapted for this context and for the specific needs of a country.

The GHS is a worldwide initiative to promote standard criteria for classifying chemicals according to their health, physical, and environmental hazards. It uses pictograms, hazard statements, and the signal words "Danger" and "Warning" to communicate hazard information on product labels and safety data sheets in a logical and comprehensive way. The primary goal of GHS is better protection of human health and the environment by providing chemical users and handlers with enhanced and consistent information on chemical hazards.

The GHS addresses classification of chemicals by types of hazard and proposes harmonised hazard communication elements, including labels and safety data sheets. It aims at ensuring that information on physical hazards and toxicity from chemicals be available in order to enhance the protection of human health and the environment during the handling, transport, and use of these chemicals. The GHS also provides a basis for harmonisation of rules and regulations on chemicals at national, regional, and worldwide level.

The first edition of the GHS was published in 2003, with second and third revisions in 2007 and 2009 respectively. The latest (third revised edition) takes into account amendments which concern, *inter alia*: new provisions for the allocation of hazard statements and for the labelling of small packagings; two new sub-categories for respiratory and skin sensitisation; the revision of the classification criteria for long-term hazards (chronic toxicity) to the aquatic environment; and a new hazard class for substances and mixtures hazardous to the ozone layer. See: http://www.unece.org/trans/danger/publi/ghs/ghs_rev03/03files_e.html.

Examples of the Application of the GHS:

- **World Health Organization:** The *WHO Recommended Classification of Pesticides by Hazard Globally Harmonized System (GHS) of Classification and Labelling of Chemicals* sets out a classification system to distinguish between the more and the less hazardous forms of selected pesticides based on acute risk to human health (that is the risk of single or multiple exposures over a relatively short period of time). It takes into consideration the toxicity of the technical compound and its common formulations. The document lists common technical grade pesticides and recommended classifications together with a listing of active ingredients believed to be obsolete or discontinued for use as pesticides, pesticides subject to the prior informed consent procedure, limitations to trade because of the POPs convention, and gaseous or volatile fumigants not classified under these recommendations. WHO is in the process of adjusting the Pesticide Classification to conform to the GHS (see above). Further information is available at: http://www.who.int/ipcs/publications/pesticides_hazard/en/.

- **European Union:** Within the EU, the classification, labelling, and packaging (CLP) Regulation 1272/2008/EC aligns with previous EU legislation on classification, labelling, and packaging of chemicals to the GHS. The CLP Regulation was published in the Official Journal 31 December 2008 and entered into force on 20 January 2009. According to the Regulation, the deadline for substance classification according to the new rules will be 1 December 2010. For mixtures, the deadline will be 1 June 2015. The CLP Regulation will ultimately replace the current rules on classification, labelling, and packaging of substances (Directive 67/548/EEC) and preparations (Directive 1999/45/EC) after this transitional period. Further information is available at: http://ec.europa.eu/enterprise/sectors/chemicals/documents/classification/index_en.htm.

  The Seveso II Directive will be aligned to the CLP Regulation by a separate amendment.

Text Box 8

ALTERNATIVE APPROACHES FOR SPECIFYING THE SCOPE OF A CHEMICAL ACCIDENTS PROGRAMME

This box sets out four approaches for establishing the scope of the chemical accidents programme, along with some of the advantages and disadvantages of each. These are not the only possible approaches.

Option 1: Develop a list of selected hazardous substances with threshold quantities

Advantages
A recognised list of selected substances means that the scope of the programme is easily defined. The first version of the Seveso Directive (82/501/EEC), adopted in 1982, followed this principle and was the model for international conventions and for other national regulations.

Disadvantages
The major problems with a list of selected substances are that each substance is dealt with independently, and there may be some important substances that are not listed and, therefore, are not covered by the programme. If the list is included in legislation, it could be difficult to update the list. Furthermore, at some installations there may be several hazardous substances present at quantities just below the thresholds and therefore the programme would not apply despite the fact that the cumulative quantity of hazardous substances present a high level of risk. This was one of the reasons for the change of approach in the Seveso II Directive (96/82/EC).

Option 2: Develop a list of hazard classes with threshold quantities

Advantages
By considering hazard classes it is possible to address the accident hazards in total. This means that the disadvantages of a closed list of hazardous substances can be avoided. Since the number of hazard classes is limited, the implementation of the programme may be simplified. If a substance is re-classified, no new legislation is usually required to ensure appropriate coverage (or exclusion).

Disadvantages
Using hazard classes may be overly inclusive since the classes have generally been developed in order to protect human health and do not necessarily relate to the level of hazards related to chemical accidents. Furthermore, some substances have several classifications.

This might lead to capturing within the programme some installations which do not pose a high level of risk. For example, methanol is a flammable liquid which is also toxic. In industrial or commercial processes the toxic risk due to ingestion is not particularly significant in terms of a chemical accident and, thus, flammability becomes the dominating factor. There are some hazardous substances which are widely used in standardised processes *e.g.*, gasoline or diesel. It may not be appropriate to regulate these substances within the corresponding hazard classes.

Option 3: Develop a selection of hazard classes together with a list of specifically named substances along with threshold quantities

Advantages
By selecting some hazard classes and specific hazardous substances, the advantages for both option 1 and option 2 are utilised. The Seveso II Directive and the UNECE Convention follow the approach described in Option 3.

Disadvantages
This solution can lead to complicated calculations for determining the application of the programme. The provision of information, tables, and software solutions can help to minimise these problems.

Option 4: Identify Types of Industries Handling Hazardous Chemicals

Advantages
For countries with a limited number of installations or types of installations handling hazardous substances, this is a very simple approach to focus attention on those industries for which hazards are likely or for which hazards have already been identified. Authorities can review each of the installations in the specified industries to determine whether to include them in the scope of the programme and can consider whether threshold quantities should be established for the hazardous substances in these installations.

Text Box 8 *(continued)*

This could be a good way to start when resources are limited, and it could provide a basis for understanding what threshold limits might be appropriate in the future.

Disadvantages
This approach is limited to dealing with existing situations and does not address new hazardous installations that are not within the designated industries. Care has to be taken to avoid capturing too many installations (*i.e.*, those within the designated industry but which do not have sufficient quantities of hazardous chemicals to pose a substantial risk to health, the environment, or property). There is also the risk that the programme will miss hazardous installations that are not known to the authorities.

Excerpts from International Instruments

ILO CONVENTION

PART I: SCOPE AND DEFINITIONS

Article 1

1. The purpose of this Convention is the prevention of major accidents involving hazardous substances and the limitation of the consequences of such accidents.
2. This Convention applies to major hazard installations.
3. This Convention does not apply to:
   a. nuclear installations and plants processing radioactive substances except for facilities handling non-radioactive substances at these installations;
   b. military installations;
   c. transport outside the site of an installation other than by pipeline.
4. A Member ratifying this Convention may, after consulting the representative organisations of employers and workers concerned and other interested parties who may be affected, exclude from the application of the Convention installations or branches of economic activity for which equivalent protection is provided.

Article 3

Contains definitions including:

a. the ***term hazardous*** substance means a substance or mixture of substances which by virtue of chemical, physical, or toxicological properties, either singly or in combination, constitutes a hazard;
b. the term ***threshold quantity*** means for a given hazardous substance or category of substances that quantity, prescribed in national laws and regulations by reference to specific conditions, which, if exceeded, identifies a major hazard installation;
c. the term ***major hazard installation*** means one which produces, processes, handles, uses, disposes of or stores, either permanently or temporarily, one or more hazardous substances or categories of substances in quantities which exceed the threshold quantity;
d. the term ***major accident*** means a sudden occurrence - such as a major emission, fire, or explosion - in the course of an activity within a major hazard installation, involving one or more hazardous substances and leading to a serious danger to workers, the public, or the environment, whether immediate or delayed.

UNECE CONVENTION

Article 1 – Definitions

"Hazardous activity" is defined as any activity in which one or more hazardous substances are present or may be present in quantities at or in excess of the threshold quantities listed in Annex I hereto, and which is capable of causing transboundary effects.

Article 2 – Scope

This Convention shall apply to the prevention of, preparedness for, and response to industrial accidents capable of causing transboundary effects, including the effects of such accidents caused by natural disasters, and to international cooperation concerning mutual assistance, research and development, exchange of information, and exchange of technology in the area of prevention of, preparedness for, and response to industrial accidents.

There are exemptions for nine types of facilities (*e.g.*, military, dam failures, accidents involving genetically modified organisms, etc.).

Annex I contains the list of substances for the purpose of defining hazardous activities. This list is similar to the list from the Seveso II Directive.

SEVESO II DIRECTIVE (see Annex III for the list of substances and thresholds)

Article 2: Scope

1. The Directive shall apply to establishments where dangerous substances are present in quantities equal to or in excess of the quantities listed in Annex I, Parts 1 and 2, column 2, with the exception of Articles 9, 11, and 13 which shall apply to any establishment where dangerous substances are present in quantities equal to or in excess of the quantities listed in Annex I, Parts 1 and 2, column 3.

   For the purposes of this Directive, the "presence of dangerous substances" shall mean the actual or anticipated presence of such substances in the establishment, or the presence of those which it is believed may be generated during loss of control of an industrial chemical process, in quantities equal to or in excess of the thresholds in Parts I and 2 of Annex I.

2. The provisions of this Directive shall apply without prejudice to Community provisions concerning the working environment, and, in particular, without prejudice to Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work (OJ No L 183, 29.6.1989, p.1).

Article 3: Definitions

For the purposes of this Directive:

1. ***'establishment'*** shall mean the whole area under the control of an operator where dangerous substances are present in one or more installations, including common or related infrastructures or activities;
2. ***'installation'*** shall mean a technical unit within an establishment in which dangerous substances are produced, used, handled, or stored. It shall include all the equipment, structures, pipework, machinery, tools, private railway sidings, docks, unloading quays serving the installation, jetties, warehouses, or similar structures, floating or otherwise, necessary for the operation of the installation;
3. ***'operator'*** shall mean any individual or corporate body who operates or holds an establishment or installation or, if provided for by national legislation, has been given decisive economic power in the technical operation thereof;
4. ***'dangerous substance'*** shall mean a substance, mixture, or preparation listed in Annex 1, Part 1, or fulfilling the criteria laid down in Annex 1, Part 2, and present as a raw material, product, by-product, residue, or intermediate, including those substances which it is reasonable to suppose may be generated in the event of an accident;
5. ***'major accident'*** shall mean an occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of any establishment covered by this Directive, and leading to serious danger to human health and/or the environment, immediate or delayed, inside or outside the establishment, and involving one or more dangerous substances;
6. ***'hazard'*** shall mean the intrinsic property of a dangerous substance or physical situation, with a potential for creating damage to human health and/or the environment;

Seveso II Directive *(continued)*

7. ***'risk'*** shall mean the likelihood of a specific effect occurring within a specified period or in specified circumstances;
8. ***'storage'*** shall mean the presence of a quantity of dangerous substances for the purposes of warehousing, depositing in safe custody, or keeping in stock.

Article 4 – Exclusions

This Directive shall not apply to the following:

a. military establishments, installations, or storage facilities;

b. hazards created by ionising radiation;

c. the transport of dangerous substances and intermediate temporary storage by road, rail, internal waterways, sea, or air, outside the establishments covered by this Directive, including loading and unloading and transport to and from another means of transport at docks, wharves, or marshalling yards;

d. the transport of dangerous substances in pipelines, including pumping stations, outside establishments covered by this Directive;

e. the exploitation (exploration, extraction, and processing) of minerals in mines, quarries, or by means of boreholes, with the exception of chemical and thermal processing operations and storage related to those operations which involve dangerous substances, as defined in Annex I;

f. waste land-fill sites.

US LAWS[24]

(See Annex III (Lists of Chemicals of Concern) on page 143 for the list of substances and thresholds)

According to guidance prepared by the US EPA:

Owners and operators of stationary sources at which **regulated or any other extremely hazardous substances** are present in a process, regardless of the amount of the substance, **are subject to the general duty clause in section 112(r)(1)**. This general duty clause directs all owners and operators of stationary sources to identify hazards that may results from accidental releases, to design and maintain a safe facility, and to minimize the consequences of release when they occur.

The Risk Management Plan (RMP) Program requirements apply to owners and operators of stationary sources that have more than a threshold quantity of a regulated substance contained in a process (40 CFR 68.115).

The definition of "process" is very broad, and includes any use, storage, manufacturing, handling, on-site movement, or any combination of these activities. Any group of vessels that are interconnected, or separate vessels that are located such that a regulated substance could be involved in a potential release, is considered a single process.

The regulation specifically covers any facility with a regulated substance above the threshold in a process, regardless of whether the owner or operator is a State, its political subdivision, the Federal government, or a private entity.

The RMP chemicals and thresholds overlap with chemicals listed under other US rules, but are not identical to those on any other list. The RMP chemical list and corresponding thresholds for each chemical are published at 40 CFR 68.130, Tables 1 and 2 (toxic substances) and Tables 3 and 4 (flammable substances) and are available on the Office of Emergency Management (OEM) website at: http://www.epa.gov/emergencies/.

The regulations include a number of exemptions including, for example, ammonia used as an agricultural nutrient, when held by farmers, and flammable substances used as fuel, or held for sale as fuel at a retail facility.

The regulations contain numerous definitions.

[24]The US laws and regulations are difficult to quote directly, because they are contained in a number of different documents and have some language that is specific to the US context. Therefore, a number of the excerpts in this Chapter do not contain direct language from US law.

Some of the primary US regulations are cited in Annex VI (Selected Bibliography) on page 170 and all the regulations are available on the US EPA website at: www.epa.gov/emergencies.

C3: Role of "Competent Authorities" (Government)[25]

a. Overview

Goals

- *Clearly identify which authorities are responsible for each element of the chemical accidents programme.*
- *Ensure that the authorities have the resources (including appropriate levels of trained staff) to fulfil their responsibilities.*
- *Take the steps necessary to implement the elements of the chemical accidents programme and promote chemical safety by all stakeholders.*

Why

Without a designation of authorities, and the allocation of resources, it is not possible to oversee and enforce the elements of the chemical accidents programme.

The authorities should also take a leadership role in motivating all stakeholders to recognise the need for accident prevention and take appropriate steps to help develop a national culture that promotes accident prevention.

See Text Box 9 (Key Roles of Competent Authorities) on page 69 for a summary of the key roles of competent authorities.

How

- Allocate roles and responsibilities in a manner that is consistent with the existing political and cultural context. While the experience of other countries may be instructive, it should not be the determining factor in the allocation.
- Start this process by undertaking an assessment of the authorities' roles, and the resources required, as part of the process of developing the chemical accidents programme. This may be an iterative process, addressing the role of the competent authorities as the different elements are elaborated.
- In allocating responsibilities to the appropriate authorities, consider whether there should be more than one authority involved in the implementation of different elements of the programme and how to minimise any overlaps and potential conflicts between authorities.
- Ensure that there are qualified staff to carry out the authorities' roles. The roles should be differentiated (*e.g.*, the task of an inspector cannot be carried out by an administrator).
- Maintain staff training programmes (for initial and ongoing training) to ensure continuing competency.
- Seek help from external sources (*e.g.*, consultants) if the expertise needed to carry out some of their responsibilities is not available internally.
- Establish a mechanism to help ensure cooperation and coordination among the authorities, which is necessary for effective implementation. It can also address consultation with non-governmental stakeholders.
- Address the establishment of enforcement procedures, including sanctions for non-compliance with requirements.

More information on the requirements for competent authorities when establishing a chemical accidents programme can be found in Chapter B, Section B5 (Implementation Phase) on page 46.

[25]The term "competent authority" refers to the government body that is legally delegated or designated to carry out identified functions. The term competent authority is used in the Seveso II Directive.

Pitfalls

- Having a shortage of qualified staff for each role (including, as appropriate, technical/scientific background and training).
- Failure to retain qualified staff.
- Having insufficient resources for the authorities to carry out their designated roles.
- Failure to keep up with technology and maintain competency.
- Conflicts or overlaps between the roles of different authorities.
- Lack of effective coordination between multiple authorities leading to gaps, overlapping activities, and conflicts.

Text Box 9

KEY ROLES OF COMPETENT AUTHORITIES (GOVERNMENT)

- develop, implement, and continuously improve laws, regulations, policies, and practices;
- enforce laws and regulations;
- monitor industry, including on-site inspections, to help ensure compliance with requirements and to check that the elements of the SMS are functioning properly;
- provide leadership to motivate all stakeholders to fulfil their responsibilities;
- maintain inventory of hazardous installations;
- review documentation provided by the installations;
- establish and implement appropriate land-use planning arrangements;
- provide guidance on how regulatory requirements can be met;
- facilitate education and information exchange and promote voluntary initiatives;
- ensure that information is provided to the public;
- promote coordination and cooperation among relevant authorities, and with other stakeholders;
- ensure that off-site preparedness planning is undertaken;
- mitigate the effects of accidents through appropriate response measures;
- maintain information (databases) of accidents;
- conduct investigations of significant accidents, in particular those which may provide important lessons; and
- facilitate exchange of experience within the country and between countries.

b. Information Management

Goal

Establish systems to manage the information needed for a chemical accidents programme.

Why

Information is critical to many aspects of an effective chemical accidents programme, in order to assess risks, determine priorities, and improve safety.

The types of information that are needed include: inventories of hazardous installations and chemicals; translations of chemical names in local languages; directories identifying characteristics of hazardous substances; risk assessments and safety reports; inspection reports; accident case histories and investigations; information on health impacts; hospital records; and guidance materials for industry and for the public.

Therefore, systems are needed to collect, catalogue, and maintain up-to-date information, and to be able to access information when needed.

How

- Establish databases and other mechanisms to facilitate the collection, maintenance, understanding, and updating of information (including, for example: an inventory of hazardous installations; a database on hazardous substances of concern; risk assessments/safety reports and other information on individual installations; inspection reports; information needed for response and medical treatment for victims; accident databases; accident investigations reports).
- Systematically collect, catalogue, record, and review information.
- Access information from international organisations (*e.g.*, on chemical hazards).
- Establish mechanisms for the exchange of information within the country and between countries with a goal to improve chemical safety (*e.g.*, among different authorities, between authorities and industry, among inspectors).
- Participate in international efforts that promote information exchange.

Additional information is available in Chapter B, Section B5, part (b) (Information Access and Sharing) on page 50.

Note: there are no excerpts from legal instruments for this element. All countries with chemical accidents programmes have systems to manage information. This is critical for implementation. This is generally not mandated in the law but, rather, is part of the implementation process.

Pitfalls

- Information overload (*i.e.*, responders need focused information to make quick decisions, not complete information on the risks of chemicals).
- Information that is incomplete or not maintained up to date.
- Information that is collected but is not accessible.
- Institutional memory that is lost because information is known or accessible by limited number of employees.

c. Inspections

Goal

An effective inspection programme for hazardous installations is maintained in order to check compliance with requirements, ensure proper safety practices, and share experience.

Why

An inspection programme can help to ensure that hazardous installations are being operated in accordance with the standards established in the programme and with good practices, and to determine whether safety management systems are in place and operating within acceptable safety limits.

Inspections provide an opportunity for sharing of experience and guidance between industry and authorities and for gaining confidence about the safety of hazardous installations.

In addition, inspections can help to determine priorities for future inspections and for the chemical accidents programme more generally.

How

- Identify the installations subject to inspection.
- Establish procedures for undertaking audits/inspections that are appropriate for the types of hazardous activities, with clearly defined goals. There should be common protocols and guidance to allow for comparisons between different inspections.
- Carry out inspections on a regular basis, within an inspection programme that takes into account available resources/personnel. Normally, inspections programmes include provision for both scheduled inspections as well as unscheduled "spot checks." Inspections should also be carried out as the result of "triggering events" (*e.g.*, complaints, accidents, new knowledge).
- Plan and structure regular inspections to take account of available resources as well as the characteristics of the relevant installations (*e.g.*, types of operations, levels of risks, considerations unique to a particular installation). The frequency of inspections can be done at different levels depending on the level of risk.
- Create strategies and tools to ensure that the coverage and focus of inspections remain consistent with the objectives of the chemical accidents programme over time.
- Ensure that inspections address the technical, organisational and managerial aspects of the installation.
- Ensure that inspection authorities have sufficient resources and trained personnel.
- Ensure that inspectors have the necessary authority to enter and inspect hazardous installations and obtain necessary information.
- Ensure that inspectors have the information, equipment, and other resources that they need (such as transport, personal protective equipment [PPE], computers, software).
- Hire competent staff and train inspectors so they know the protocols and inspection techniques, and understand how to inspect technical aspects, human factors, and other relevant aspects. Establish a strategy for maintaining inspector competency and learning from experience. Exchange of information from accidents and inspections is key.
- Develop procedures that inspectors should follow in advance of the inspection so that they will be adequately prepared. For example, inspectors should review the relevant safety report(s), previous inspection reports, permits, and related documentation provided to the authorities. The inspection should also provide an opportunity for the inspectors to check the accuracy of relevant parts of the safety report(s).
- Require preparation of inspection reports after each inspection, with identification of deficiencies, recommendations for remedial actions, and enforcement measures, as appropriate. Share report with owners/operators.
  - The follow-up actions should be designed to ensure that the identified shortcomings are addressed in an appropriate and timely fashion, and that there is verification of actions taken.

- Establish mechanisms to ensure remedial actions are carried out.
- Provide inspectors with the appropriate tools to address concerns identified including, for example, timetables for action, citations, fines, and when there are gross deficiencies or the imminent threat of an accident, the ability to stop operations.
- Coordinate among relevant inspection organisations (*e.g.*, those responsible for environmental protection, occupational health and safety, public health, and emergency response at national, regional, and local levels) to minimise duplicative efforts, reduce the burden on industry, share resources, and learn from others' experience. Such cooperation also benefits industry by, for example, avoiding multiple inspections and minimising conflicting results.
- Involve workers at the installation and, as appropriate, other stakeholders in the inspection process.

Pitfalls

- There is a need to ensure that an inspection does not relieve the owner/operator[26] of the responsibility for the safety of their hazardous installations (*i.e.*, avoid any inference that authorities take on legal responsibilities for the safety of installations just because they were inspected).
- Care should be given to determining appropriate priorities for inspections, recognising that it is not possible to inspect all installations every year. In addition, it is not possible (or necessarily productive) to inspect every single aspect of an installation during one inspection.
- Without the proper training in all aspects of the inspection process, inspectors often focus on the technical aspects of the facility and neglect the human factors, safety management, etc.
- There can be too much reliance on check-lists (by themselves). The use of check-lists for carrying out inspections can lead to "closed" inspections which assess known potential problems. Developing "open"-inspection skills and techniques requires experience and training to be aware of what characterises "hazardous activities" or poor safety management.
- Inspections cannot be effective if inspectors are not prepared, for example if they do not have sufficient information in advance to have an understanding of the operations and hazards at the installation.
- If not enough time is allocated to an on-site inspection, or if there is a lack of preparation, the result is a superficial inspection which does not give a true impression of the safety of the installation.

All inspection programmes should have some common elements, which are critical to their success. Specifically, they each should have:

- clearly defined goals;
- an identified scope;
- a schedule (a plan of action with time-frames);
- appropriate experts who are trained and qualified for the specific tasks and goals;
- reviews of appropriate documentation, as well as interviews with key personnel;
- an identification of deficiencies and proper practices;
- a formal report of findings;
- a management review to clearly define responsibilities for follow-up actions and a means for ensuring that the actions are carried out; and
- a demonstration that the follow-up actions have been carried out.

[26]For purposes of this *Guidance*, "owner/operator" is defined as an individual or legal entity (public or private) having decision-making responsibility for an installation (including management).

Excerpts from International Instruments

ILO CONVENTION

Article 18

1. The competent authority shall have properly qualified and trained staff with the appropriate skills, and sufficient technical and professional support, to inspect, investigate, assess, and advise on the matters dealt with in this Convention and to ensure compliance with national laws and regulations.
2. Representatives of the employer and representatives of the workers of a major hazard installation shall have the opportunity to accompany inspectors supervising the application of the measures prescribed in pursuance of this Convention, unless the inspectors consider, in the light of the general instructions of the competent authority, that this may be prejudicial to the performance of their duties.

UNECE CONVENTION

Annex IV: Preventive Measures Pursuant to Article 6

The following measures may be carried out, depending on national laws and practices, by Parties, competent authorities, operators, or by joint efforts:

…

9. The monitoring and auditing of hazardous activities and the carrying out of inspections.

SEVESO II DIRECTIVE

Article 18: Inspections

1. Member States shall ensure that the competent authorities organise a system of inspections, or other measures of control appropriate to the type of establishment concerned. Those inspections or control measures shall not be dependent upon receipt of the safety report or any other report submitted. Such inspections or other control measures shall be sufficient for a planned and systematic examination of the systems being employed at the establishment, whether of a technical, organisational, or managerial nature, so as to ensure in particular:
   - that the operator can demonstrate that he has taken appropriate measures, in connection with the various activities involved in the establishment, to prevent major accidents,
   - that the operator can demonstrate that he has provided appropriate means for limiting the consequences of major accidents, on site and off site,
   - that the data and information contained in the safety report, or any other report submitted, adequately reflects the conditions in the establishment,
   - that information has been supplied to the public pursuant to Article 13 (1).
2. The system of inspection specified in paragraph 1 shall comply with the following conditions:
   a. there shall be a programme of inspections for all establishments. Unless the competent authority has established a programme of inspections based upon a systematic appraisal of major-accident hazards of the particular establishment concerned, the programme shall entail at least one on-site inspection made by the competent authority every twelve months of each establishment covered by Article 9;
   b. following each inspection, a report shall be prepared by the competent authority,
   c. where necessary, every inspection carried out by the competent authority shall be followed up with the management of the establishment, within a reasonable period following the inspection.
3. The competent authority may require the operator to provide any additional information necessary to allow the authority fully to assess the possibility of a major accident and to determine the scope of possible increased probability and/or aggravation of major accidents, to permit the preparation of an external emergency plan, and to take substances into account which, due to their physical form, particular conditions, or location, may require additional consideration.

US LAWS

Risk Management Plan Program

§ 68.220 Audits

a. In addition to inspections for the purpose of regulatory development and enforcement of the Act, the implementing agency shall periodically audit RMPs submitted under subpart G of this part to review the adequacy of such RMPs and require revisions of RMPs when necessary to ensure compliance with subpart G of this part.

b. The implementing agency shall select stationary sources for audits based on any of the following criteria:

1. Accident history of the stationary source;
2. Accident history of other stationary sources in the same industry;
3. Quantity of regulated substances present at the stationary source;
4. Location of the stationary source and its proximity to the public and environmental receptors;
5. The presence of specific regulated substances;
6. The hazards identified in the RMP; and
7. A plan providing for neutral, random oversight.

…

d. The implementing agency shall have access to the stationary source, supporting documentation, and any area where an accidental release could occur.

e. Based on the audit, the implementing agency may issue the owner or operator of a stationary source a written preliminary determination of necessary revisions to the stationary source's RMP to ensure that the RMP meets the criteria of subpart G of this part. The preliminary determination shall include an explanation for the basis for the revisions, reflecting industry standards and guidelines (such as AIChE/CCPS guidelines and ASME and API standards) to the extent that such standards and guidelines are applicable, and shall include a timetable for their implementation.

f. Written response to a preliminary determination. (1) The owner or operator shall respond in writing to a preliminary determination made in accordance with paragraph (e) of this section. The response shall state the owner or operator will implement the revisions contained in the preliminary determination in accordance with the timetable included in the preliminary determination or shall state that the owner or operator rejects the revisions in whole or in part. For each rejected revision, the owner or operator shall explain the basis for rejecting such revision. Such explanation may include substitute revisions.

…

2. The written response under paragraph (f)(1) of this section shall be received by the implementing agency within 90 days of the issue of the preliminary determination or a shorter period of time as the implementing agency specifies in the preliminary determination as necessary to protect public health and the environment. Prior to the written response being due and upon written request from the owner or operator, the implementing agency may provide in writing additional time for the response to be received.

g. After providing the owner or operator an opportunity to respond under paragraph (f) of this section, the implementing agency may issue the owner or operator a written final determination of necessary revisions to the stationary source's RMP. The final determination may adopt or modify the revisions contained in the preliminary determination under paragraph (e) of this section or may adopt or modify the substitute revisions provided in the response under paragraph (f) of this section. A final determination that adopts a revision rejected by the owner or operator shall include an explanation of the basis for the revision. A final determination that fails to adopt a substitute revision provided under paragraph (f) of this section shall include an explanation of the basis for finding such substitute revision unreasonable.

h. Thirty days after completion of the actions detailed in the implementation schedule set in the final determination under paragraph (g) of this section, the owner or operator shall be in violation of subpart G of this part and this section unless the owner or operator revises the RMP prepared under subpart G of this part as required by the final determination, and submits the revised RMP as required under §68.150.

i. The public shall have access to the preliminary determinations, responses, and final determinations under this section in a manner consistent with §68.210.

d. Preparedness Planning

Goal

Authorities ensure that there is adequate preparedness planning so that adverse effects of chemical accidents are effectively mitigated.

Why

It is not possible to totally eliminate the risk of a chemical accident at hazardous installations even with the best accident prevention system in place. In other words, not all incidents can be avoided and there is always a residual risk that an accident can occur. Therefore, appropriate preparedness planning is important in order to effectively respond to accidents and, thereby, minimise adverse impacts.

Additional information on emergency planning is provided in:

- Text Box 10 (Issues to be Addressed in Emergency Preparedness Planning) on page 76;
- Text Box 11 (International Assistance in the Event of a Major Environmental Emergency/Industrial Accidents) on page 81;
- SG-3 (Guidance on Emergency Planning) on page 126; and
- SG-4 (Guidance on Health Aspects of Chemical Accidents) on page 129.

Effective chemical emergency preparedness and response programmes are the last defence – after technical measures have failed and/or human errors have taken place – to protect the public, the environment, and property from the consequences of accidents involving hazardous substances.

Preparedness planning is a joint responsibility of government authorities, industry, and others:

- Owners/operators should be responsible for on-site preparedness planning, addressing possible impacts within the boundaries of the installation (on-site plans), and for providing the information needed by authorities to develop off-site plans.
- Public authorities are generally responsible for off-site preparedness planning to protect the community, the environment, and property outside the boundaries of the installation.

How

- Require owners/operators of hazardous installations to develop on-site plans, based on identification and assessment of potential risks, and an elaboration of possible accident scenarios.
- Provide guidance and standards to assist industry. This guidance should address how to develop, implement, test, and update on-site plans. Authorities should also ensure that the public is aware of the on-site plans.
- Require owners/operators to give public authorities the information needed to develop off-site plans.
- Develop off-site plans at the local level which identify the hazardous installations and their risks in the community.
- Invite all parties potentially involved in the response, as well as the public, to participate in the preparation of off-site plans. This would include emergency responders as well as medical and public health professionals.
- Ensure that emergency planning reflects a realistic assessment of what is needed for an appropriate response based on a range of possible accident scenarios. The planning process should include an assessment of the skills, equipment, and other resources that are available for the response effort.
- Take into account potential complicating factors that could make response more difficult (such as extreme weather conditions, natural disasters, loss of power or water supplies, trouble with communication and transportation systems, domino effects).
- Allow, in the planning, for flexible response to a range of possible situations (from small accidents to worst-case scenarios).
- Identify the roles and responsibilities of all parties concerned and describe the chain of command and lines of communication.

- Include an elaboration on how to warn and inform the public on what to do in the event of an emergency.
- Ensure integration and coordination of on-site and off-site plans.
- Regularly test and review the plans so that they are maintained up-to-date and take into account lessons learned from accidents.
- Include provisions for mutual aid in off-site plans, including local, regional, and national plans.

Pitfalls

- Emergency plans that present an ideal, rather than a realistic, assessment of risks and resources (including human, technical and financial resources) that are needed in the event of an emergency.
- Written emergency plans that are put on the shelf and not considered until an emergency takes place.
- No training is conducted in the implementation of the plans and no exercises are undertaken to test the plans.
- Outdated emergency plans because of changes in the risks, resources, or personnel involved. It is important that emergency plans are kept up-to-date, taking into account developments (new risks, changes in resources, population shifts, etc.), as well as experience gained as the result of exercises and emergency response operations.
- Staff that is not competent to carry out their assigned responsibilities or who become complacent. There needs to be regular reviews, training, and exercises so all involved know their responsibilities and they don't forget or become complacent.
- Failure to take into account the fact that an accident may occur during non-working hours and/or under bad weather conditions.
- Failure to recognise that accidents can destroy communication centres and other response facilities.
- Failure to take into account possible effects across borders. Lack of information about possible impacts across borders (other localities and countries) can lead to insufficient planning and response.

Text Box 10

ISSUES TO BE ADDRESSED IN EMERGENCY PREPAREDNESS PLANNING

(from UNEP'S Awareness and Preparedness for Emergencies at Local Level – APELL Handbook)

Identify local agencies making up the community's potential local awareness and response preparedness network

- Fire department
- Police/militia
- Emergency health service associated with local hospitals or fire and police departments
- Emergency management or civil defence agency
- Public health agency
- Environmental agency
- Public works and/or transportation departments
- Red Cross/Crescent
- Other local community resources such as public housing, schools, public utilities, communications, religious organisations, non-governmental organisations (NGOs)

Identify the hazards that may produce an emergency situation

While one tends to think of chemical manufacturing facilities, other operations should also be reviewed for potential major hazards. These may include:

- Major industrial facilities (refineries, steel mills, paper mills, etc.)
- Small processing facilities which may store or use hazardous materials
- Hospitals
- Transportation and warehousing facilities

Text Box 10 *(continued)*

Establish the current status of community planning and coordination for hazardous materials emergency preparedness and assure that potential overlaps in planning are avoided

- Existence of community planning and coordination bodies, their structure, and authority
- Existence of community assessments of current prevention and response capabilities within the emergency response network
- Existence of an up-dated technical reference library of response procedures for hazardous materials, maintained by the community
- Information on past training seminars, simulations, or mock incidents performed by the community in conjunction with local industry and other organisations (including information on their frequency, place, date, and notes on simulated casualties)

Identify the specific community points of contact and their responsibilities in an emergency

- Listing the agencies involved, area of responsibility, name of the contact, position, 24-hour telephone number, and the chain of command
- Availability of specific chemical or toxicological expertise in the community, either in industry, colleges or universities, poison control centres, or consultancies

List the kind of equipment and materials which are available at the local level to respond to emergencies

- Making the equipment, material, and personal available to trained users at the scene of an incident

Identify organisational structure for handling emergencies

- Emergency response plans already in place
- Coordination of existing plans to facilitate effectiveness and avoid gaps in the organised response to any emergency
- Clarification of the chain of command

Check if the community has specialised emergency response teams to respond to hazardous materials releases

- Training of local emergency services on hazardous materials
- Availability and use of specialised equipment by local emergency services
- Capacity of local hospitals to decontaminate and treat numerous exposure victims quickly and effectively
- Existence of specialised industry response teams, governmental response teams, or other response teams within or close to the community
- Average time for emergency response teams to arrive on the scene
- Industry's resources made available to the community to help respond to emergencies

Define the community emergency transportation network

- Designation of specific community evacuation routes
- Public awareness of designated evacuation routes
- Specific access routes designated for emergency response and services personnel to reach facilities or incident sites

Establish the community procedures for protecting citizens during emergencies

Set up a mechanism that enables responders to exchange information or ideas during an emergency with other entities

Excerpts from International Instruments

ILO CONVENTION

Article 9

In respect of each major hazard installation employers shall establish and maintain a documented system of major hazard control which includes provision for;

...

d. emergency plans and procedures, including:

   i. the preparation of effective site emergency plans and procedures, including emergency medical procedures, to be applied in case of major accidents or threat thereof, with periodic testing and evaluation of their effectiveness and revision as necessary;

   ii. the provision of information on potential accidents and site emergency plans to authorities and bodies responsible for the preparation of emergency plans and procedures for the protection of the public and the environment outside the site of the installation;

   iii. any necessary consultation with such authorities and bodies;

e. measures to limit the consequences of a major accident.

Article 15

Taking into account the information provided by the employer, the competent authority shall ensure that emergency plans and procedures containing provisions for the protection of the public and the environment outside the site of each major hazard installation are established, updated at appropriate intervals and coordinated with the relevant authorities and bodies.

UNECE CONVENTION

Article 8: Emergency Preparedness

1. The Parties shall take appropriate measures to establish and maintain adequate emergency preparedness to respond to industrial accidents. The Parties shall ensure that preparedness measures are taken to mitigate transboundary effects of such accidents, on-site duties being undertaken by operators. These measures may include, but are not limited to those referred to in Annex VII hereto. In particular, the Parties concerned shall inform each other of their contingency plans.

2. The Party of origin shall ensure for hazardous activities the preparation and implementation of on-site contingency plans, including suitable measures for response and other measures to prevent and minimise transboundary effects. The Party of origin shall provide to the other Parties concerned the elements it has for the elaboration of contingency plans.

3. Each Party shall ensure for hazardous activities the preparation and implementation of off-site contingency plans covering measures to be taken within its territory to prevent and minimise transboundary effects. In preparing these plans, account shall be taken of the conclusions of analysis and evaluation, in particular the matters set out in Annex V, paragraph 2, subparagraphs (1) to (5). Parties concerned shall endeavour to make such plans compatible. Where appropriate, joint off-site contingency plans shall be drawn up in order to facilitate the adoption of adequate response measures.

4. Contingency plans should be reviewed regularly, or when circumstances so require, taking into account the experience gained in dealing with actual emergencies.

SEVESO II DIRECTIVE

Article 11: Emergency plans

1. Member States shall ensure that, for all establishments to which Article 9 applies:

   a. the operator draws up an internal emergency plan for the measures to be taken inside the establishment,

      – for new establishments, prior to commencing operation,

      – for existing establishments not previously covered by Directive 82/501/EEC, three years from the date laid down in Article 24 (1),

Seveso II Directive *(continued)*

- for other establishments, two years from the date laid down in Article 24 (1),
- for establishments which subsequently fall within the scope of this Directive, without delay, but at all events within one year after the date on which this Directive applies to the establishment concerned, as laid down in the first subparagraph of Article 2 (1);

b. the operator supplies to the competent authorities, to enable the latter to draw up external emergency plans, the necessary information within the following periods of time:

- for new establishments, prior to the start of operation,
- for existing establishments not previously covered by Directive 82/501/EEC, three years from the date laid down in Article 24 (1),
- for other establishments, two years from the date laid down in Article 24 (1),
- for establishments which subsequently fall within the scope of this Directive, without delay, but at all events within one year after the date on which this Directive applies to the establishment concerned, as laid down in the first subparagraph of Article 2 (1);

c. the authorities designated for that purpose by the Member State draw up an external emergency plan for the measures to be taken outside the establishment.

2. The emergency plans must be established with the objectives of:

- containing and controlling incidents so as to minimize the effects, and to limit damage to man, the environment and property,
- implementing the measures necessary to protect man and the environment from the effects of major accidents,
- communicating the necessary information to the public and to the services or authorities concerned in the area,
- providing for the restoration and clean-up of the environment following a major accident.

Emergency plans shall contain the information set out in Annex IV.

3. Without prejudice to the obligations of the competent authorities, Member States shall ensure that the internal emergency plans provided for in this Directive are drawn up in consultation with the personnel working inside the establishment, including long-term relevant subcontracted personnel, and that the public is consulted on external emergency plans when they are established or updated.

4. Member States shall ensure that internal and external emergency plans are reviewed, tested, and where necessary revised and updated by the operators and designated authorities at suitable intervals of no longer than three years. The review shall take into account changes occurring in the establishments concerned or within the emergency services concerned, new technical knowledge, and knowledge concerning the response to major accidents.

4a. With regard to external emergency plans, Member States should take into account the need to facilitate enhanced cooperation in civil protection assistance in major emergencies.

5. Member States shall ensure that emergency plans are put into effect without delay by the operator and, if necessary by the competent authority designated for this purpose:

- when a major accident occurs, or
- when an uncontrolled event occurs which by its nature could reasonably be expected to lead to a major accident.

6. The competent authority may decide, giving reasons for its decision, in view of the information contained in the safety report, that the requirement to produce an external emergency plan under paragraph 1 shall not apply.

Annex IV: Data and information to be included in the emergency plans specified under Article 11

1. Internal emergency plans

a. Names or positions of persons authorized to set emergency procedures in motion and the person in charge of and coordinating the on-site mitigatory action.

b. Name or position of the person with responsibility for liaising with the authority responsible for the external emergency plan.

c. For foreseeable conditions or events which could be significant in bringing about a major accident, a description of the action which should be taken to control the conditions or events and to limit their consequences, including a description of the safety equipment and the resources available.

Seveso II Directive *(continued)*

d. Arrangements for limiting the risks to persons on site including how warnings are to be given and the actions persons are expected to take on receipt of a warning.

e. Arrangements for providing early warning of the incident to the authority responsible for setting the external emergency plan in motion, the type of information which should be contained in an initial warning and the arrangements for the provision of more detailed information as it becomes available.

f. Arrangements for training staff in the duties they will be expected to perform, and where necessary coordinating this with off-site emergency services.

g. Arrangements for providing assistance with off-site mitigatory action.

2. External emergency plans

a. Names or positions of persons authorized to set emergency procedures in motion and of persons authorized to take charge of and coordinate off-site action.

b. Arrangements for receiving early warning of incidents, and alert and call-out procedures.

c. Arrangements for coordinating resources necessary to implement the external emergency plan.

d. Arrangements for providing assistance with on-site mitigatory action.

e. Arrangements for off-site mitigatory action.

f. Arrangements for providing the public with specific information relating to the accident and the behaviour which it should adopt.

g. Arrangements for the provision of information to the emergency services of other Member States in the event of a major accident with possible transboundary consequences.

US LAWS

Pursuant to the **Emergency Planning and Community Right-to-Know Act** (EPCRA) (42 USC 116), local governments are required to prepare chemical emergency response plans, and to review plans at least annually. EPCRA requires US States to create State Emergency Response Commissions (SERCs) and requires local communities to form Local Emergency Planning Committees (LEPCs) to prepare local emergency response plans for chemical accidents and periodically test and exercise the plans. State governments are required to oversee and coordinate local planning efforts. EPCRA also requires facilities to provide LEPCs with information necessary for emergency planning, and to submit annual inventory reports and information about hazardous chemicals at the facility to SERCs, LEPCs, and local fire departments. LEPCs are also required to provide all appropriate information on the local emergency response plan and the chemicals in their community to the public.

Text Box 11

INTERNATIONAL ASSISTANCE IN THE EVENT OF A MAJOR ENVIRONMENTAL EMERGENCY/INDUSTRIAL ACCIDENTS

The Joint UNEP/OCHA Environment Unit (JEU):

The JEU is the United Nations mechanism created to mobilise and coordinate emergency assistance to countries affected by environmental emergencies and natural disasters with significant environmental impact.

The JEU has full access to OCHA's tools and services for response, including the United Nations Disaster Assessment and Coordination (UNDAC) teams. The Joint Environment Unit links to UNEP through the Division of Environmental Policy Implementation (DEPI), and its Post-Conflict Disaster Management Branch (PCDMB) responsible for the implementation of environmental policy in order to foster sustainable development at global, regional, and national levels.

The Joint Unit is available 24 hours a day, 7 days a week, year-round to mobilise assistance for those facing emergencies.

The Joint Unit may only mobilise assistance when specifically requested to do so by an affected country. Assistance to environmental emergencies can be requested by:

- Completing the form:
  'Environmental Emergency Notification/Request for International Assistance.' This form should be completed by national authorities and sent to the Joint Environment Unit.
- Contacting OCHA's Emergency Hotline: +41/22 917 2010.

See: http://ochaonline.un.org/ochaunep

The Monitoring and Information Centre (MIC), operated by the European Commission in Brussels:

The MIC is the operational heart of the Community Mechanism for Civil Protection. It is available on a 24/7 basis and is staffed by duty officers working on a shift basis. It gives countries access to the Community civil protection platform.

Any country affected by a major disaster – inside or outside the EU – can launch a request for assistance through the MIC.

See: http://ec.europa.eu/echo/civil_protection/civil/prote/mic.htm.

e. Siting and Land-Use Planning

Goal

Locate hazardous facilities to minimise adverse effects to the community in the event of an accident, and to restrict developments near existing installations with the objective of maintaining appropriate distances between hazardous installations and areas of public use or sensitive environments.

Why

Appropriate land-use planning and siting of hazardous installations can help to minimise the adverse effects of accidents.

Land-use planning can be used to help protect the community, as well as the environment and property, outside the boundaries of the installation from the exposure to direct and indirect effects of chemical accidents.

Land-use planning can also be used to prevent an increase in the risk associated with a particular establishment, by managing developments near hazardous installations, especially since there is a tendency to build homes and other facilities close to industrial areas.

Land-use planning is a tool that is used to achieve a number of objectives, not just improved chemical safety. Therefore, land-use planning can be a complex process and it may be necessary for decision-makers to balance a variety of potentially competing goals.

How

- Set clear zoning and land-use standards concerning siting of new installations and modifications to existing installations.
- Establish standards requiring scrutiny of any proposals for development near hazardous installations, and limiting new facilities with public access near such installations (*e.g.*, including residences, businesses, schools, hospitals, transport facilities, etc.).
- Take into account specific local circumstances when deciding on the siting of installations, including the possibility of natural disasters in the area.
- Review the locations of existing hazardous installations, in relation to nearby developments, to decide whether there are appropriate safe distances and, if not, determine what further actions are needed to protect human health and the environment.
- Involve the public in land-use planning decisions.

Pitfalls

- Unbalanced application of land-use planning principles. This can happen when the principles and related guidance are not clear.
- Failure of decision-makers to take chemical safety into account. Existing land-use policies often have been established for other reasons and, therefore, do not usually address chemical accident risks. So, it may be difficult to incorporate the concepts inherent in chemical accident prevention and preparedness in existing land-use policies.
- Difficulty in coordination among authorities. The authority responsible for land-use planning is generally different than those concerned with other aspects of chemical accidents (*e.g.*, siting and land-use decisions are often made at local level). Therefore, coordination is important in order for the land-use authorities to have the information needed to make an informed decision.
- People moving near existing hazardous installations to be close to employment opportunities and public services. This may lead to informal developments that are difficult to control (as was the case at Bhopal accident).
- Installations located in populated areas as a result of historical development. This makes it difficult to formulate stringent rules for land-use planning and, therefore, a case-by-case approach for existing facilities may be necessary.

Excerpts from International Instruments

ILO CONVENTION

Article 17

The competent authority shall establish a comprehensive siting policy arranging for the appropriate separation of proposed major hazard installations from working and residential areas and public facilities, and appropriate measures for existing installations. Such a policy shall reflect the General Principles set out in Part II of the Convention.

UNECE CONVENTION

Article 7: Decision-making on Siting

Within the framework of its legal system, the Party of origin shall, with the objective of minimizing the risk to the population and the environment of all affected Parties, seek the establishment of policies on the siting of new hazardous activities and on significant modifications to existing hazardous activities. Within the framework of their legal systems, the affected Parties shall seek the establishment of policies on significant developments in areas which could be affected by transboundary effects of an industrial accident arising out of a hazardous activity so as to minimize the risks involved. In elaborating and establishing these policies, the Parties should consider the matters set out in Annex V, paragraph 2, subparagraphs (1) to (8), and Annex VI hereto.

SEVESO II DIRECTIVE

Article 12: Land-use planning

1. Member States shall ensure that the objectives of preventing major accidents and limiting the consequences of such accidents are taken into account in their land-use policies and/or other relevant policies. They shall pursue those objectives through controls on:

   a. the siting of new establishments,

   b. modifications to existing establishments covered by Article 10,

   c. new developments such as transport links, locations frequented by the public and residential areas in the vicinity of existing establishments, where the siting or developments are such as to increase the risk or consequences of a major accident.

   Member States shall ensure that their land-use and/or other relevant policies and the procedures for implementing those policies take account of the need, in the long term, to maintain appropriate distances between establishments covered by this Directive and residential areas, buildings and areas of public use, major transport routes as far as possible, recreational areas and areas of particular natural sensitivity or interest and, in the case of existing establishments, of the need for additional technical measures in accordance with Article 5 so as not to increase the risks to people.

1a. The Commission is invited by 31 December 2006, in close cooperation with the Member States, to draw up guidelines defining a technical database including risk data and risk scenarios, to be used for assessing the compatibility between the establishments covered by this Directive and the areas described in paragraph 1. The definition of this database shall as far as possible take account of the evaluations made by the competent authorities, the information obtained from operators and all other relevant information such as the socioeconomic benefits of development and the mitigating effects of emergency plans.

2. Member States shall ensure that all competent authorities and planning authorities responsible for decisions in this area set up appropriate consultation procedures to facilitate implementation of the policies established under paragraph 1. The procedures shall be designed to ensure that technical advice on the risks arising from the establishment is available, either on a case-by-case or on a generic basis, when decisions are taken.

US LAWS

In the US, siting and land-use planning are the responsibilities of local governments.

C4: Requirements of Industry (Hazardous Installations)

a. Overview

Goals

- *Establish a safety culture, reflected in policies and procedures, with all employees understanding the importance of safety and acting accordingly.*
- *Develop and implement a safety management system so that hazards and risks are identified and assessed, appropriate technology and processes are used, proper procedures are in place, and an effective organisational structure is established.*
- *Prepare for any accidents that might occur.*
- *Seek continuous improvements.*

Why

Industries are responsible for the safety of their installations. Therefore, safety should be an integral part of the business operations of an enterprise and all hazardous installations need to create a safety culture complemented by technology, policies, procedures, and systems that are appropriate to their circumstances.

While it is not possible, nor desirable, for authorities to be responsible for the safe operation of hazardous installations, authorities can enact laws, develop guidance, and establish programmes to encourage the responsible and safe handling of chemicals by all enterprises. Authorities can also communicate with enterprises in order that requirements are clear, relevant, and obtainable.

Enterprises must comply with any requirements and should cooperate with authorities (as well as with workers and other stakeholders) to achieve the objectives and spirit of the laws, programmes, and policies.

The fact that the chemical accidents programme is in place, and that authorities are involved in review and inspection activities, does not diminish the fact that responsibility for the safety of hazardous installations rests with the enterprise/operator.

How

The following are general steps that owners and operators of hazardous installations should take to improve chemical accident prevention and preparedness. Authorities can encourage the following practices at hazardous installations through outreach, communication, educational programmes and, where applicable, requirements and other aspects of the chemical accidents programme.

- Know the hazards and risks at installations where there are hazardous substances. Conduct risk analysis activities to understand the potential hazards and consequences of an accident.
- Promote a “safety culture” that is known and accepted by workers and managers throughout the enterprise.
- Establish safety management systems and regularly monitor/review their implementation.
- Utilise “inherently safer technology” principles in designing and operating hazardous installations.[27]
- Be especially diligent in managing change.
- Prepare for any accidents that might occur.
- Assist others to carry out their respective roles and responsibilities.
- Seek continuous improvement.

[27]Additional information on inherent safety is provided in Text Box 13 (Prevention of Chemical Accidents: Inherent Safety) on page 95.

- Encourage workers to be informed of chemical hazards and provide information and feedback to management regarding hazards and safety measures.
- Be proactive in helping to inform and educate the surrounding communities.

Industry associations can be a valuable source of information and guidance to individual installations that may not have extensive resources for improved chemical management, and large organisations can help improve chemical safety throughout their value chain by engaging suppliers and customers in chemical safety activities.

Pitfalls

- Overcoming the perception that improved chemical management is a hindrance to financial success and growth.
- Having a shortage of qualified staff.
- Avoiding any inference that the government is responsible for safety at hazardous installations because they have been involved in regulatory activities, inspections, or related efforts.

b. General Duty Clause

Goal

Establish the principle as a matter of law that owners/operators of hazardous installations have the responsibility for the safe operation of their installations.

Why

The safety of a hazardous installation should be the responsibility of the owner/operator of the installation. A General Duty Clause allows a country to establish that principle as a matter of law.

This is important because it is not possible for legal instruments to address all potential hazards, or to specify everything that an owner/operator should do with respect to accident prevention and preparedness. Nor is it possible for the government to control or even monitor all hazardous installations.

Thus, a General Duty Clause supplements any specific requirements of the chemical accidents programme. Each country should consider how best to express this principle in a manner that is consistent with their legal and cultural context.

Overview of Some General Duty Clauses

Seveso Directive: Member States shall ensure that the operator is obliged to take all measures necessary to prevent major accidents and to limit their consequences for man and the environment.

US Risk Management Plan: Owners/operators have a general duty to identify hazards, to design and maintain a safe facility taking such steps as are necessary to prevent releases, and to minimise the consequences of accidental releases which do occur.

Swiss Ordinance: Requires the owner of a facility to take all appropriate measures to reduce risk consistent with the state of the art of safety technology and personal experience. They must take all economically viable measures to reduce hazards, to prevent accidents, and limit the consequences of possible accidents should they occur.[28]

The practical effect of a General Duty Clause is that the owner/operation of any hazardous installation should carry out an assessment of the hazards which may lead to an accident and then adopt measures to prevent the accident or, in the event of an accident taking place despite these measures, to limit the consequences for health, the environment, and property.

How

- Establish the principle in the chemical accidents programme that owners/operators of hazardous installations have the responsibility for the safety of their installations. This obligation can be stated in general terms, for example that the owner/operator is obliged to take all measures necessary for the safe performance of the hazardous activity and for the prevention of industrial accidents, or that the owner/operator is responsible for the design, construction, and operation of the installation in a safe manner with respect to the risks posed. The programme can include specific requirements, such that the owner/operator maintains documentation to demonstrate to authorities that they are fulfilling this duty.
- Include enforcement measures or sanctions in appropriate laws, regulations, or other instruments, which can be imposed if an owner/operator is found to be operating an installation in an unsafe manner.
- Provide assistance or guidance to help owners/operators fulfil their responsibilities.

[28]See Gmuender, Felix K, Meyer, Patrick, and Schiess, Martin "The Control of Major Hazardous in Switzerland in the Framework of Sustainable Development – Liquified Petroleum, Ammonia and Chlorine as Examples" at: http://www.gmuender.org/stfv/ControlMajorHazards.pdf.

Pitfalls

- Difficulties in enforcing the General Duty Clause, because the level of the burden of proof is not clear. Lack of clarity can lead to under- or over-enforcement depending on a country's legal norms and precedent. For example, it may be difficult to enforce the General Duty Clause if there are requirements that the authority establish a certain burden of proof. Conversely, if burden of proof is largely placed on the operator, then lack of a clear interpretation of the General Duty Clause may result in an overextension of government authority in this area.
- Problems in reaching a common understanding of what relevant terms mean, such as "all measures necessary."

Excerpts from International Instruments

ILO CONVENTION

Convention 155* – Article 16

1. Employers shall be required to ensure that, so far as is reasonably practicable, the workplaces, machinery, equipment and processes under their control are safe and without risk to health.
2. Employers shall be required to ensure that, so far as is reasonably practicable, the chemical, physical and biological substances and agents under their control are without risk to health when the appropriate measures of protection are taken.

Convention 174 – Article 9

In respect of each major hazard installation employers shall establish and maintain a documented system of major hazard control.

* Convention 155 is the Convention on Occupational Safety and Health

UNECE CONVENTION

Article 3: General Provisions

...

3. The Parties shall ensure that the operator is obliged to take all measures necessary for the safe performance of the hazardous activity and for the prevention of industrial accidents.

SEVESO II DIRECTIVE

Article 5: General obligations of the operator

1. Member States shall ensure that the operator is obliged to take all measures necessary to prevent major accidents and to limit their consequences for man and the environment.
2. Member States shall ensure that the operator is required to prove to the competent authority referred to in Article 16, hereinafter referred to as the 'competent authority', at any time, in particular for the purposes of the inspections and controls referred to in Article 18, that he has taken all the measures necessary as specified in this Directive.

US LAWS

Clean Air Act Section 112

...

r. **Prevention of Accidental Releases**

1. **Purpose and General Duty –** It shall be the objective of the regulations and programs authorized under this subsection to prevent the accidental release and to minimize the consequences of any such release of any substance listed pursuant to paragraph (3) or any other extremely hazardous substance. The owners and operators of stationary sources producing, processing, handling or storing such substances have a general duty, in the same manner and to the same extent as section 654, title 29 of the United States Code, to identify hazards which may result from such releases using appropriate hazard assessment techniques, to design and maintain a safe facility taking such steps as are necessary to prevent releases, and to minimize the consequences of accidental releases which do occur.

For guidance on the application of the General Duty Clause, see:
http://www.epa.gov/compliance/resources/policies/civil/caa/gdc/gendutyclause-rpt.pdf.

c. Notification

Goal

Authorities are aware of any installations which fall within the scope of their chemical accidents programme and that they have basic information about these installations.

Why

Through the use of a notification procedure, countries can gain an understanding of the nature and extent of potential risks in their country.

The information obtained as a result of the notifications also provides:

- a basis for developing an inventory of the hazardous installations that fall within the scope of the chemical accidents programme;
- information to help create and implement tiers of requirements, based on the level of risk posed by different installations; and
- the data needed to establish priorities and allocate resources for implementation and enforcement and to undertake appropriate preparedness planning.

Generally, notification is a basic requirement for any installation falling within the scope of the chemical accidents programme (*i.e.*, meeting the specified criteria and/or thresholds).

The notification process can trigger the application of a "tiered" approach. This means that hazardous installations are divided into two or more groups depending on their level of risks and hazards. In a tiered approach, the higher the risk, the more information is required to be submitted as a follow-up to the notification process. So while all installations included within the scope of the programme would be subject to the basic notification requirements, certain installations that meet established criteria might be subject to greater reporting requirements to show that the installation is taking adequate action to prevent accidents. Being in the higher tier might trigger other actions such as more frequent inspections. Furthermore, the most hazardous installations may be subject to restrictions or a permit system in light of the seriousness of associated hazards.

How

- Establish the requirement that owners/operators of hazardous installations notify the competent authorities of the existence of any installations that fall within the scope of the chemical accidents programme. This requirement should include three elements:
  - the deadline for sending the notification for existing and for new installations (generally before the installation is built), and for any significant modifications to the installation;
  - the information that should be included in the notification. This would normally involve information on the nature of the processes and the substances at the installation, as well as information on the owner/operator; and
  - sanctions for owners/operators that do not comply with the notification requirement.
- Ensure that the scope of the notification procedure is clear.
- Establish an administrative structure to collect and catalogue the notifications.
- Establish a system to review the notifications and to seek clarifications or follow-up information.
- Develop a database or system to manage/retain the information of interest. More information on systems for information management and sharing can be found in Chapter B, Section B5, part (b) (Information Access and Sharing) on page 50 and Chapter C, Section C3, part (b) (Information Management) on page 70.
- Establish criteria for those installations that may be subject to additional reporting requirements. Further discussion on the types of information that industries should provide to authorities can be found in Chapter C, Section C4, part (f) (Safety Reports) on page 98.

Pitfalls:

- Failure to have clear identification of the scope of the programme.
- Lack of a system or insufficient numbers of trained staff to receive, catalogue, and/or review the notifications.

Excerpts from International Instruments

ILO CONVENTION

Article 7

Employers shall identify any major hazard installation within their control on the basis of the system referred to in Article 5.

Article 8

1. Employers shall notify the competent authority of any major hazard installation which they have identified:
   a. within a fixed time-frame for an existing installation;
   b. before it is put into operation in the case of a new installation.
2. Employers shall also notify the competent authority before any permanent closure of a major hazard installation.

SEVESO II DIRECTIVE

Article 6: Notification

1. Member States shall require the operator to send the competent authority a notification within the following time-limits:
   – for new establishments, a reasonable period of time prior to the start of construction or operation,
   – for existing establishments, one year from the date laid down in Article 24 (1),
   – for establishments which subsequently fall within the scope of this Directive, within three months after the date on which this Directive applies to the establishment concerned, as laid down in the first subparagraph of Article 2(1).
2. The notification required by paragraph 1 shall contain the following details:
   a. the name or trade name of the operator and the full address of the establishment concerned;
   b. the registered place of business of the operator, with the full address;
   c. the name or position of the person in charge of the establishment, if different from (a);
   d. information sufficient to identify the dangerous substances or category of substances involved;
   e. the quantity and physical form of the dangerous substance or substances involved;
   f. the activity or proposed activity of the installation or storage facility;
   g. the immediate environment of the establishment (elements liable to cause a major accident or to aggravate the consequences thereof).
3. In the case of existing establishments for which the operator has already provided all the information under paragraph 2 to the competent authority under the requirements of national law at the date of entry into force of this Directive, notification under paragraph 1 is not required.
4. In the event of:
   – any significant increase in the quantity or significant change in the nature or physical form of the dangerous substance present, as indicated in the notification provided by the operator pursuant to paragraph 2, or any change in the processes employing it,
   – modification of an establishment or an installation which could have significant repercussions on major accident hazards, or
   – permanent closure of the installation, the operator shall immediately inform the competent authority of the change in the situation.

US LAWS

The US has several laws which require facility owners and operators to notify competent authorities that they are subject to the chemical accident program. Those laws include the Emergency Planning and Community Right-to-know Act (EPCRA) and the Clean Air Act's Risk Management Plan (RMP) Program. Under EPCRA, facilities with Extremely Hazardous Substances (EHS) over their Threshold Planning Quantity must notify the LEPC so their facility can be included in the local emergency planning process. Also, under EPCRA, if a facility has a hazardous chemical over the threshold amount they must provide an annual report to their SERCs, LEPCs, and fire departments. This report includes information on the name, amount, and location of the hazardous chemical. The RMP requirements apply to processes at facilities that have more than a threshold quantity of any of 77 acutely toxic substances, such as chlorine and ammonia, and 63 highly volatile flammable substances. If a facility meets these requirements, they must submit a Risk Management Plan.

d. Prevention Policy and Safety Management Systems

Goal

Ensure that owners/operators of hazardous installations have in place appropriate policies, and safety management systems, to prevent chemical accidents.

Why

This is the core of a chemical accidents programme, addressing the need for the owner/operator of a hazardous installation to: develop, implement and update, as appropriate, policies for accident prevention; and document the policies so that the competent authorities can review them.

How

- Each enterprise should be required to establish and implement a Prevention Policy, which provides a basis for accident prevention and preparedness in order to minimise the likelihood of an accident and to protect human health, the environment and property.
  - This Policy is statement of intent, reflecting a commitment to accident prevention and emergency preparedness, to meeting all requirements, and to continuous improvement.
  - The Policy should be communicated to all employees.
  - The Policy should be the reviewed regularly and updated in light of experience and any changes in technologies, laws, regulations, or significant changes at the hazardous installation.
- Those enterprises that meet specified criteria should be required to develop a Safety Management System (SMS), which includes the organisation and arrangements for implementing the Prevention Policy.
  - The elements of the SMS should be appropriate to the nature and extent of risks posed by the hazardous installation, and take into account the available resources.

Additional information on Safety Management Systems can be found in Text Box 12 (Safety Management Systems) on page 95 and SG-1 (Guidance on Safety Management Systems) on page 117.

One approach that industries can use to improve safety at hazardous installations involves the use of inherently safer processes.[29] More information on this approach is presented in Text Box 13 (Prevention of Chemical Accidents: Inherent Safety) on page 95.

Pitfalls

- A SMS is developed but it is a paper exercise and is not implemented.
- External advisors recommend standard elements of the SMS to enterprises which may not be appropriate to their specific situation (*e.g.*, the SMS may not be proportionate to the risks or fit the existing management structure of the facility). It should be recognised that there is no such thing as one size fits all for SMSs.
- Failure to adequately involve workers in the development of SMSs. Without the participation of workers, it is difficult to expect that the SMS will function effectively.[30]

[29]Inherent safety is the selection of processes, designs, and materials with the intention of reducing the risk of accidents. Examples of methods to improve inherent safety include reducing the inventory of hazardous chemicals or designing processes so that they better tolerate human errors.

[30]This issue is highlighted in Section 3.2 of the ILO Guidelines on occupational safety and health management system (ILO-OSH 2001).

Excerpts from International Instruments

ILO CONVENTION

Article 4

1. In the light of national laws and regulations, conditions and practices, and in consultation with the most representative organizations of employers and workers and with other interested parties who may be affected, each Member shall formulate, implement and periodically review a coherent national policy concerning the protection of workers, the public and the environment against the risk of major accidents.

2. This policy shall be implemented through preventive and protective measures for major hazard installations and, where practicable, shall promote the use of the best available safety technologies.

SEVESO II DIRECTIVE

Article 7: Major-accident prevention policy

1. Member States shall require the operator to draw up a document setting out his major-accident prevention policy and to ensure that it is properly implemented. The major-accident prevention policy established by the operator shall be designed to guarantee a high level of protection for man and the environment by appropriate means, structures and management systems.

1a. For establishments which subsequently fall within the scope of this Directive, the document referred to in paragraph 1 shall be drawn up without delay, but at all events within three months after the date on which this Directive applies to the establishment concerned, as laid down in the first subparagraph of Article 2(1).

2. The document must take account of the principles contained in Annex III and be made available to the competent authorities for the purposes of, amongst other things, implementation of Articles 5 (2) and 18.

3. This Article shall not apply to the establishments referred to in Article 9.

Article 9: Safety report

1. Member States shall require the operator to produce a safety report for the purposes of:

   a. demonstrating that a major-accident prevention policy and a safety management system for implementing it have been put into effect in accordance with the information set out in Annex III.

Annex III: Principles Referred to in Article 7 and Information Referred to in Article 9 on the Management System and the Organization of the Establishment with a View to the Prevention of Major Accidents

For the purpose of implementing the operator's major-accident prevention policy and safety management system account shall be taken of the following elements. The requirements laid down in the document referred to in Article 7 **should be** proportionate to the major-accident hazards presented by the establishment:

   a. the major accident prevention policy should be established in writing and should include the operator's overall aims and principles of action with respect to the control of major-accident hazards;

   b. the safety management system should include the part of the general management system which includes the organizational structure, responsibilities, practices, procedures, processes and resources for determining and implementing the major-accident prevention policy;

   c. the following issues shall be addressed by the safety management system:

      i. organization and personnel – the roles and responsibilities of personnel involved in the management of major hazards at all levels in the organisation. The identification of training needs of such personnel and the provision of the training so identified. The involvement of employees and of subcontracted personnel working in the establishment;

      ii. identification and evaluation of major hazards – adoption and implementation of procedures for systematically identifying major hazards arising from normal and abnormal operation and the assessment of their likelihood and severity;

      iii. operational control – adoption and implementation of procedures and instructions for safe operation, including maintenance, of plant, processes, equipment and temporary stoppages;

Seveso II Directive *(continued)*

iv. management of change – adoption and implementation of procedures for planning modifications to, or the design of new installations, processes or storage facilities;

v. planning for emergencies – adoption and implementation of procedures to identify foreseeable emergencies by systematic analysis, to prepare, test and review emergency plans to respond to such emergencies and to provide specific training for the staff concerned. Such training shall be given to all personnel working in the establishment, including relevant subcontracted personnel;

vi. monitoring performance – adoption and implementation of procedures for the ongoing assessment of compliance with the objectives set by the operator's major-accident prevention policy and safety management system, and the mechanisms for investigation and taking corrective action in case of non-compliance. The procedures should cover the operator's system for reporting major accidents of near misses, particularly those involving failure of protective measures, and their investigation and follow-up on the basis of lessons learned;

vii. audit and review – adoption and implementation of procedures for periodic systematic assessment of the major-accident prevention policy and the effectiveness and suitability of the safety management system; the documented review of performance of the policy and safety management system and its updating by senior management.

US LAWS

Under the Clean Air Act's Risk Management Plan (RMP) Program, facilities with processes that have a regulated substance above a threshold quantity will be required to carry out the following elements of the prevention program for risk management planning:

- Review and documentation of the plant chemicals, processes, and equipment.
- Detailed process hazard analysis to identify hazards, assess the likelihood of accidental releases, and evaluate the consequences of such releases.
- Development of standard operating procedures.
- Training of employees on procedures.
- Implementation of a preventive maintenance program.
- Management of changes in operation that may impact the safety of the system
- Reviews before initial start-up of a process and before start-up following a modification of a process.
- Investigation and documentation of accidents.
- Periodic safety audits to ensure that procedures and practices are being followed.

Text Box 12

SAFETY MANAGEMENT SYSTEMS

A Safety Management System (SMS) should address the organisational structure, practices, procedures and resources for implementing the corporate Safety Policy and should include, at a minimum:

- Organisational structure (including the roles, responsibilities, training, education, qualifications, and inter-relationship of individuals involved in work affecting safety).
- Identification and evaluation of hazards (developing and implementing formal procedures to systematically identify and evaluate hazards – including their likelihood and severity – arising from normal and abnormal operations, and including the hazards arising from handling, production, transportation, storage or disposal of hazardous substances).
- Facilities and operational control (addressing design and construction, as well as the procedures for safe operation, including maintenance of plant, processes, equipment and temporary stoppages).
- Management of change (planning and controlling changes in: organisation; personnel; plant; processes, including pre-start up reviews, maintenance and decommissioning; materials; equipment; procedures; software; design; and external circumstances that are capable of affecting safety).
- Planning for emergencies (related to developing, adopting, implementing, reviewing, testing and, when appropriate, revising and updating emergency plans).
- Monitoring performance (concerning the ongoing assessment of compliance with the Safety Policy and safety management system, and mechanisms for taking corrective action in the event of non-compliance).
- Audit and review (addressing the periodic, systematic assessment of the Safety Policy and effectiveness and suitability of the safety management system).
- Accident investigation and learning from experience.

This is based on the OECD *Guiding Principles for Chemical Accident Prevention, Preparedness and Response* (2nd ed., 2003).

Text Box 13

PREVENTION OF CHEMICAL ACCIDENTS: INHERENT SAFETY

Some countries require or encourage enterprises to use "inherently safer" technology and/or state of the art technology to reduce the risk of chemical accidents.

This refers to the careful selection of the process, along with the good design of the installation in order to, in effect, design out certain hazards; minimise the effects of human error; and better tolerate errors that might occur. This does not mean that there is no residual risk but, rather, that design decisions are made with the intent of reducing risk.

To meet the objective of inherently safer technology, there are a number of concepts that can be employed, to the extent that they decrease overall risk. These include:

- reducing inventories of hazardous substances;
- minimising, to the extent practicable, the use of hazardous substances;
- replacing hazardous materials by less hazardous ones;
- using hazardous materials or processes in a way that limits their hazard potential (*e.g.*, through closed systems, using less reactive substances);
- making the plant and process simpler to design, build and operate;
- moderating process conditions (*e.g.*, pressure levels);
- shifting complex systems to simpler ones;
- adapting the nature and extent of transport within, to, and from the installation;
- ensuring use of redundant safety systems; and
- minimising production of hazardous wastes.

It is important to consider all the consequences of the design decisions. For example, while reducing inventories may reduce the accident risk on-site, it may increase the risk of transport accidents if there is a need to increase the number of road or rail deliveries of the hazardous substance.

This is based on the OECD *Guiding Principles for Chemical Accident Prevention, Preparedness and Response* (2nd ed., 2003).

e. Hazard Identification and Risk Assessment

Goal

Appropriate hazard identifications and risk assessments are conducted, and maintained, for all hazardous installations.

Why

Safety management starts with the identification of the hazards and assessment of the risks at hazardous installations. These form the basis of developing a prevention policy and a preparedness plan.

Risk assessment is a tool used to help understand risks and inform the selection and prioritisation of prevention and control strategies.

Risk assessments allow risks to be ranked on a relative scale and options can be evaluated to maximise chemical safety.

How

- Provide guidance to enterprises on doing risk assessments.
- Require enterprises subject to the chemical accidents programme to undertake hazard identifications and risk assessments. There are a number of different approaches to doing hazard identification and risk assessment, and the enterprises should choose approaches that are appropriate to their circumstances.
- Enterprises should develop and adopt procedures for hazard identification and risk assessment, in light of the properties and quantities of the substances at the installation along with the processes involved.
  - The procedures should be formal, systematic and written.
  - The risk assessment should take account of all possible consequences of accidents (including health and environmental effects).
- Risk assessments should be reviewed and revised periodically, and any time there is a significant change at the installation (*e.g.*, change in technology or information, an incident), to ensure that information reflects the current situation.
- Enterprises should strive for transparency in the assessment process and include specialists, employees and other stakeholders.

More information is provided in SG-2 (Guidance on Risk Assessment) on page 122.

Pitfalls

- Failure to use appropriate procedures resulting in insufficient or inaccurate information that forms the basis for prevention and preparedness activities.
- Failure to keep the hazard identification and risk assessment current so that they reflect the actual situation at the hazardous installation.

Excerpts from International Instruments

ILO CONVENTION

Article 9

In respect of each major hazard installation employers shall establish and maintain a documented system of major hazard control which includes provision for:

a. the identification and analysis of hazards and the assessment of risks including consideration of possible interactions between substances;

UNECE CONVENTION

Article 4: Identification, Consultation and Advice

1. For the purpose of undertaking preventive measures and setting up preparedness measures, the Party of origin shall take measures, as appropriate, to identify hazardous activities within its jurisdiction and to ensure that affected Parties are notified of any such proposed or existing activity.
2. Parties concerned shall, at the initiative of any such Party, enter into discussions on the identification of those hazardous activities that are reasonably capable of causing transboundary effects. If the Parties concerned do not agree on whether an activity is such a hazardous activity, any such Party may, unless the Parties concerned agree on another method of resolving the question, submit that question to an inquiry commission in accordance with the provisions of Annex II hereto for advice,
3. The Parties shall, with respect to proposed or existing hazardous activities, apply the procedures set out in Annex III hereto.
4. When a hazardous activity is subject to an environmental impact assessment in accordance with the Convention on Environmental Impact Assessment in a Transboundary Context and that assessment includes an evaluation of the transboundary effects of industrial accidents from the hazardous activity which is performed in conformity with the terms of this Convention, the final decision taken for the purposes of the Convention on Environmental Impact Assessment in a Transboundary Context shall fulfil the relevant requirements of this Convention.

SEVESO II DIRECTIVE

Annex II: Minimum Data and Information to be Considered in the Safety Report Specified in Article 9

...

IV. Identification and accidental risks analysis and prevention methods

a. detailed description of the possible major-accident scenarios and their probability or the conditions under which they occur including a summary of the events which may play a role in triggering each of these scenarios, the causes being internal or external to the installation;

b. assessment of the extent and severity of the consequences of identified major accidents;

c. description of technical parameters and equipment used for the safety of installations.

Annex III: Principles referred to in Article 7 and information referred to in Article 9 on the management system and the organization of the establishment with a view to the prevention of major accidents

...

c. the following issues shall be addressed by the safety management system:

...

ii. identification and evaluation of major hazards - adoption and implementation of procedures for systematically identifying major hazards arising from normal and abnormal operation and the assessment of their likelihood and severity

US LAWS

Under the Risk Management Plan Program, facilities are required to complete a hazard assessment. The hazard assessment consists of two components:

(a) A five-year history of serious accidents involving the regulated substances. Every covered facility must provide detailed information on any serious accident that occurred in the previous five years and had specific impacts either on the site or in the surrounding community.

(b) Descriptions of one or more potential accidental release scenarios involving the regulated substances. Every facility must analyze the potential offsite consequences of a worst-case (catastrophic) release.

EPA has defined the parameters of a worst-case scenario (such as atmospheric conditions, endpoints, and release criteria) for this analysis. In addition, if the worst-case scenario could impact the public, one or more alternative releases that are more likely to occur must be examined.

For each release scenario, the facility must estimate the greatest distance from the facility to a point beyond which no serious acute effects are anticipated. The facility must also identify the populations and environments potentially affected.

f. Safety Reports

Goal

Owners/operators prepare reports which: provide insights on reducing risks and improving efficiency; and demonstrate to the competent authorities that the risks posed by their facilities have been systematically assessed and that appropriate measures have been taken to reduce those risks, and to respond to and mitigate the effects of any accident.

Why

Safety reports can be a very important element of any chemical accidents programme. The preparation of a safety report, or similar type of document, provides important insights for the owner/operator, and the employees, of the installation to identify opportunities to improve safety and operate more efficiently. Starting with a hazard identification and risk assessment, the report provides the basis for determining whether safety measures are operating as intended and whether safety is getting better or worse over time.

By reviewing the reports, authorities have:

- insights for identifying priority areas for authorities' activities;
- a basis for establishing the inspection programme;
- an understanding of what enforcement measures may need to be taken;
- risk-related information needed for land-use planning;
- data that can be used to supplement the inventory of hazardous installations; and
- important input into the emergency planning process – both on-site and off-site planning – allowing emergency plans to be realistic.

How

- Decide which installations are subject to the requirements for submission of a safety report. It is important that the target group for this requirement is clear.
- Specify what should be included in the report.[31] At a minimum, the owner/operator is generally required to demonstrate that the installation has: identified and assessed the hazards/risks at the installation; taken measures to prevent possible accidents and limit consequences should an accident occur; established an accident prevention policy and a safety management system; and demonstrated that they have an adequate on-site preparedness plan.
- Decide whether different information should be requested from different installations depending on their levels of hazards / risks either using a tiered system or on a case-by-case basis.
- Establish the deadline for reporting requirements, including when updates need to be prepared (e.g., on a regular basis, if problems are identified, when modifications occur, etc.).
- Systematically record and catalogue safety reports.
- Provide guidance on the development of these reports.
- Identify the authorities responsible for receiving and reviewing the reports.
- Establish a clear process and criteria for reviewing the reports and provide timely and precise feedback.
- Ensure that there are sufficient numbers of competent personnel to collect and review reports that are submitted.

Pitfalls

- False presumption that an installation is being operated safely just because it submitted a safety report or a risk management plan.

[31] Additional information on the typical elements of safety reports is provided in Text Box 14 (Safety Reports) on page 99.

- Low quality reports. Care must be taken in the preparation of the report so that it provides an accurate and up-to-date picture of the installation and its operations. The quality of the report is critical; just because a report is long and detailed does not mean it is a good quality report.
- Unrealistic reports. Often external consultants are used to develop the reports (for appropriate reasons, including time and personnel constraints). It is important that employees of an installation be involved in the development and review of the safety report in order that it accurately reflects the situation at the installation and that they learn from the report.
- Failure to learn from safety reports. The authorities may also hire external consultants to review and assess the reports due to limited internal staff. While it may be necessary to use consultants during the review and assessment process, care needs to be taken that the authorities' staff benefit from the process to learn about the safety of the installations subject to the chemical accidents programme.

Text Box 14

SAFETY REPORTS

Safety reports describe the significant chemical hazards at installations and demonstrate that appropriate steps have been taken to manage chemical hazards and to prevent chemical accidents and to limit their consequences. The reports should be reviewed regularly and updated, as appropriate.

Typically, safety reports are required to include a description of, or a reference to, documents addressing:

- the installation, including its purpose, activities, layout, intrinsic hazards, hazardous substances, personnel, services, and technical equipment;
- the area surrounding the installation, including sensitive environments, the population and activities in the area (including commercial, residential, and industrial activities);
- hazard identification and risk assessment of the installation
- the on-site emergency plan, including the relationship with off-site plans and communication and coordination with emergency response personnel;
- the corporate Safety Policy;
- the enterprise's safety management system; and
- the procedures for internal reporting of incidents.

This is based on the OECD *Guiding Principles for Chemical Accident Prevention, Preparedness and Response* (2nd ed., 2003).

For further guidance on the preparation of safety reports, see the document prepared by the Major Hazards Bureau of the European Commission: *Guidance on the Preparation of a Safety Report to meet the requirements of the Seveso II Directive* available at: http://mahb.jrc.ec.europa.eu/index.php?id=55.

Excerpts from International Instruments

ILO CONVENTION

Article 9

In respect of each major hazard installation employers shall establish and maintain a documented system of major hazard control which includes provision for:

a. the identification and analysis of hazards and the assessment of risks including consideration of possible interactions between substances;

b. technical measures, including design, safety systems, construction, choice of chemicals, operation, maintenance and systematic inspection of the installation;

c. organizational measures, including training and instruction of personnel, the provision of equipment in order to ensure their safety, staffing levels, hours of work, definition of responsibilities, and controls on outside contractors and temporary workers on the site of the installation;

d. emergency plans and procedures, including:

ILO Convention *(continued)*

i. the preparation of effective site emergency plans and procedures, including emergency medical procedures, to be applied in case of major accidents or threat thereof, with periodic testing and evaluation of their effectiveness and revision as necessary;

ii. the provision of information on potential accidents and site emergency plans to authorities and bodies responsible for the preparation of emergency plans and procedures for the protection of the public and the environment outside the site of the installation;

iii. any necessary consultation with such authorities and bodies;

e. measures to limit the consequences of a major accident;

f. consultation with workers and their representatives;

g. improvement of the system, including measures for gathering information and analysing accidents and near misses. The lessons so learnt shall be discussed with the workers and their representatives and shall be recorded in accordance with national law and practice.

Article 10

1. Employers shall prepare a safety report based on the requirements of Article 9.

2. The report shall be prepared:

a. in the case of existing major hazard installations, within a period after notification prescribed by national laws or regulations;

b. in the case of any new major hazard installation, before it is put into operation.

Article 11

Employers shall review, update and amend the safety report:

a. in the event of a modification which has a significant influence on the level of safety in the installation or its processes or in the quantities of hazardous substances present;

b. when developments in technical knowledge or in the assessment of hazards make this appropriate;

c. at intervals prescribed by national laws or regulations;

d. at the request of the competent authority.

Article 12

Employers shall transmit or make available to the competent authority the safety reports referred to in Articles 10 and 11.

UNECE CONVENTION

Article 6: Prevention

1. The Parties shall take appropriate measures for the prevention of industrial accidents, including measures to induce action by operators to reduce the risk of industrial accidents. Such measures may include, but are not limited to those referred to in Annex IV hereto.

2. With regard to any hazardous activity, the Party of origin shall require the operator to demonstrate the safe performance of the hazardous activity by the provision of information such as basic details of the process, including but not limited to, analysis and evaluation as detailed in Annex V hereto.

Annex IV: Preventive Measures Pursuant to Article 6

The following measures may be carried out, depending on national laws and practices, by Parties, competent authorities, operators, or by joint efforts:

1. The setting of general or specific safety objectives;

2. The adoption of legislative provisions or guidelines concerning safety measures and safety standards;

3. The identification of those hazardous activities which require special preventive measures, which may include a licensing or authorization system;

4. The evaluation of risk analyses or of safety studies for hazardous activities and an action plan for the implementation of necessary measures;
5. The provision to the competent authorities of the information needed to assess risks;
6. The application of the most appropriate technology in order to prevent industrial accidents and protect human beings and the environment;
7. The undertaking, in order to prevent industrial accidents, of the appropriate education and training of all persons engaged in hazardous activities on-site under both normal and abnormal conditions;
8. The establishment of internal managerial structures and practices designed to implement and maintain safety regulations effectively;
9. The monitoring and auditing of hazardous activities and the carrying out of inspections.

Annex V: Analysis and Evaluation

1. The analysis and evaluation of the hazardous activity should be performed with a scope and to a depth which vary depending on the purpose for which they are carried out.
2. The following table illustrates, for the purposes of the related Articles, matters which should be considered in the analysis and evaluation, for the purposes listed:

Purpose of analysis	Matters to be considered
Emergency Planning under Article 8	(1) The quantities and properties of hazardous under Article 8 substances on the site; (2) Brief descriptive scenarios of a representative sample of industrial accidents possibly arising from the hazardous activity, including an indication of the likelihood of each; (3) For each scenario: (a) The approximate quantity of a release; (b) The extent and severity of the resulting consequences both for people and for the non-human environment in favourable and unfavourable conditions, including the extent of resulting hazard zones; (c) The time-scale within which the industrial accident could develop from the initiating event; (d) Any action which could be taken to minimize the likelihood of escalation. (4) The size and distribution of the population in the vicinity, including any large concentrations of people potentially in the hazard zone; (5) The age, mobility, and susceptibility of that population.
Decision-making on siting under Article 7	In addition to items (1) to (5) above: (6) The severity of the harm inflicted on people and the environment, depending on the nature and circumstances of the release; (7) The distance from the location of the hazardous activity at which harmful effects on people and the environment may reasonably occur in the event of an industrial accident; (8) The same information not only for the present situation but also for planned or reasonably foreseeable future developments.
Information to the public under Article 9	In addition to items (1) to (4) above: (9) The people who may be affected by an industrial accident.
Preventive measures under Article 6	In addition to items (4) to (9) above, more detailed versions of the descriptions and assessments set out in items (1) to (3) will be needed for preventive measures. In addition to those descriptions and assessments, the following matters should also be covered: (10) The conditions and quantities in which hazardous materials are handled; (11) A list of the scenarios for the types of industrial accidents with serious effects, to include examples covering the full range of incident size and the possibility of effects from adjacent activities; (12) For each scenario, a description of the events which could initiate an industrial accident and the steps whereby it could escalate; (13) An assessment, at least in general terms, of the likelihood of each step occurring, taking into account the arrangements in (14);

UNECE Convention *(continued)*

(continued) Preventive measures under Article 6	(14) A description of the preventive measures in terms of both equipment and procedures designed to minimize the likelihood of each step occurring; (15) An assessment of the effects that deviations from normal operating conditions could have, and the consequent arrangements for safe shut-down of the hazardous activity or any part thereof in an emergency, and of the need for staff training to ensure that potentially serious deviations are recognized at an early stage and appropriate action taken; (16) An assessment of the extent to which modifications, repair work and maintenance work on the hazardous activity could place the control measures at risk, and the consequent arrangements to ensure that control is maintained.

SEVESO II DIRECTIVE

Article 9: Safety report

1. Member States shall require the operator to produce a safety report for the purposes of:

   a. demonstrating that a major-accident prevention policy and a safety management system for implementing it have been put into effect in accordance with the information set out in Annex III;

   b. demonstrating that major-accident hazards have been identified and that the necessary measures have been taken to prevent such accidents and to limit their consequences for man and the environment;

   c. demonstrating that adequate safety and reliability have been incorporated into the design, construction, operation and maintenance of any installation, storage facility, equipment and infrastructure connected with its operation which are linked to major-accident hazards inside the establishment;

   d. demonstrating that internal emergency plans have been drawn up and supplying information to enable the external plan to be drawn up in order to take the necessary measures in the event of a major accident;

   e. providing sufficient information to the competent authorities to enable decisions to be made in terms of the siting of new activities or developments around existing establishments.

2. The safety report shall contain at least the data and information listed in Annex II. It shall name the relevant organisations involved in the drawing up of the report. It shall also contain an updated inventory of the dangerous substances present in the establishment.

   Safety reports, or parts of reports, or any other equivalent reports produced in response to other legislation, may be combined to form a single safety report for the purposes of this Article, where such a format obviates the unnecessary duplication of information and the repetition of work by the operator or competent authority, on condition that all the requirements of this Article are complied with.

3. The safety report provided for in paragraph 1 shall be sent to the competent authority within the following time limits:

   - for new establishments, a reasonable period of time prior to the start of construction or of operation,
   - for existing establishments not previously covered by Directive 82/501/EEC, three years from the date laid down in Article 24 (1),
   - for other establishments, two years from the date laid down in Article 24 (1),
   - in the case of the periodic reviews provided for in paragraph 5, without delay.

4. Before the operator commences construction or operation, or in the cases referred to in the second, third and fourth indents of paragraph 3, the competent authority shall within a reasonable period of receipt of the report:

   - communicate the conclusions of its examination of the safety report to the operator, if necessary after requesting further information, or
   - prohibit the bringing into use, or the continued use, of the establishment concerned, in accordance with the powers and procedures laid down in Article 17.

5. The safety report shall be periodically reviewed and where necessary updated:

   - at least every five years,
   - at any other time at the initiative of the operator or the request of the competent authority, where justified by new facts or to take account of new technical knowledge about safety matters, for example arising from analysis of accidents or, as far as possible, 'near misses', and of developments in knowledge concerning the assessment of hazards.

Seveso II Directive *(continued)*

6. a. Where it is demonstrated to the satisfaction of the competent authority that particular substances present at the establishment, or any part thereof, are in a state incapable of creating a major-accident hazard, then the Member State may, in accordance with the criteria referred to in subparagraph (b), limit the information required in safety reports to those matters which are relevant to the prevention of residual major-accident hazards and the limitation of their consequences for man and the environment.

   b. Before this Directive is brought into application, the Commission, acting in accordance with the procedure laid down in Article 16 of Directive 82/501/EEC, shall establish harmonized criteria for the decision by the competent authority that an establishment is in a state incapable of creating a major accident hazard within the meaning of subparagraph (a). Subparagraph (a) shall not be applicable until those criteria have been established.

   c. Member States shall ensure that the competent authority communicates a list of the establishments concerned to the Commission, giving reasons. The Commission shall forward the lists annually to the Committee referred to in Article 22.

Annex II: Minimum Data and Information to be Considered in the Safety Report Specified in Article 9

I. Information on the management system and on the organization of the establishment with a view to major accident prevention
   This information shall contain the elements given in Annex III.

II. Presentation of the environment of the establishment

   a. description of the site and its environment including the geographical location, meteorological, geological, hydrographic conditions and, if necessary, its history;

   b. identification of installations and other activities of the establishment which could present a major-accident hazard;

   c. description of areas where a major accident may occur.

III. Description of the installation

   a. description of the main activities and products of the parts of the establishment which are important from the point of view of safety, sources of major-accident risks and conditions under which such a major accident could happen, together with a description of proposed preventive measures;

   b. description of processes, in particular the operating methods;

   c. description of dangerous substances:

      1. inventory of dangerous substances including

         – the identification of dangerous substances: chemical name, CAS number, name according to IUPAC nomenclature;

         – the maximum quantity of dangerous substances present or likely to be present;

      2. physical, chemical, toxicological characteristics and indication of the hazards, both immediate and delayed for man and the environment;

      3. physical and chemical behaviour under normal conditions of use or under foreseeable accidental conditions.

IV. Identification and accidental risks analysis and prevention methods

   a. detailed description of the possible major-accident scenarios and their probability or the conditions under which they occur including a summary of the events which may play a role in triggering each of these scenarios, the causes being internal or external to the installation;

   b. assessment of the extent and severity of the consequences of identified major accidents including maps, images or, as appropriate, equivalent descriptions, showing areas which are liable to be affected by such accidents arising from the establishment, subject to the provisions of Articles 13(4) and 20;

   c. description of technical parameters and equipment used for the safety of installations.

V. Measures of protection and intervention to limit the consequences of an accident

   a. description of the equipment installed in the plant to limit the consequences of major accidents;

   b. organization of alert and intervention;

   c. description of mobilized resources, internal or external;

   d. summary of elements described in A, B, and C above necessary for drawing up the internal emergency plan prepared in compliance with Article 11.

Seveso II Directive *(continued)*

Annex III: Principles Referred to in Article 7 and Information Referred to in Article 9 on the Management System and the Organization of the Establishment with a View to the Prevention of Major Accidents

For the purpose of implementing the operator's major-accident prevention policy and safety management system account shall be taken of the following elements. The requirements laid down in the document referred to in Article 7 should be proportionate to the major-accident hazards presented by the establishment:

a. the major accident prevention policy should be established in writing and should include the operator's overall aims and principles of action with respect to the control of major-accident hazards;

b. the safety management system should include the part of the general management system which includes the organizational structure, responsibilities, practices, procedures, processes and resources for determining and implementing the major-accident prevention policy;

c. the following issues shall be addressed by the safety management system:

i. organization and personnel – the roles and responsibilities of personnel involved in the management of major hazards at all levels in the organisation. The identification of training needs of such personnel and the provision of the training so identified. The involvement of employees and of subcontracted personnel working in the establishment;

ii. identification and evaluation of major hazards – adoption and implementation of procedures for systematically identifying major hazards arising from normal and abnormal operation and the assessment of their likelihood and severity;

iii. operational control – adoption and implementation of procedures and instructions for safe operation, including maintenance, of plant, processes, equipment and temporary stoppages;

iv. management of change – adoption and implementation of procedures for planning modifications to, or the design of new installations, processes or storage facilities;

v. planning for emergencies – adoption and implementation of procedures to identify foreseeable emergencies by systematic analysis, to prepare, test and review emergency plans to respond to such emergencies and to provide specific training for the staff concerned. Such training shall be given to all personnel working in the establishment, including relevant subcontracted personnel;

vi. monitoring performance – adoption and implementation of procedures for the ongoing assessment of compliance with the objectives set by the operator's major-accident prevention policy and safety management system, and the mechanisms for investigation and taking corrective action in case of non-compliance. The procedures should cover the operator's system for reporting major accidents of near misses, particularly those involving failure of protective measures, and their investigation and follow-up on the basis of lessons learned;

vii. audit and review – adoption and implementation of procedures for periodic systematic assessment of the major-accident prevention policy and the effectiveness and suitability of the safety management system; the documented review of performance of the policy and safety management system and its updating by senior management.

US LAWS

Under the authority of section 112(r) of the Clean Air Act, the Chemical Accident Prevention Provisions require facilities that produce, handle, process, distribute, or store certain chemicals to develop a Risk Management Program, prepare a Risk Management Plan (RMP), and submit the RMP to EPA.

The rule defines three Program levels based on processes' relative potential for public impacts and the level of effort needed to prevent accidents. For each Program level, the rule defines requirements that reflect the level of risk and effort associated with the processes at that level. The Program levels are as follows:

Program 1: Processes which would not affect the public in the case of a worst-case release (in the language of Part 68, processes "with no public receptors within the distance to an endpoint from a worst-case release") and with no accidents with specific offsite consequences within the past five years are eligible for Program 1, which imposes limited hazard assessment requirements and minimal prevention and emergency response requirements.

Program 2: Processes not eligible for Program 1 or subject to Program 3 are placed in Program 2, which imposes streamlined prevention program requirements, as well as additional hazard assessment, management, and emergency response requirements.

US Laws *(continued)*

Program 3: Processes not eligible for Program 1 and either subject to the US Occupational Safety and Health Administration (OSHA) PSM standard under federal or state OSHA programs or classified in one of ten specified North American Industrial Classification System (NAICS) codes are placed in Program 3, which imposes OSHA's PSM standard as the prevention program as well as additional hazard assessment, management, and emergency response requirements.

Any facility with one or more covered processes must include in its RMP:

- An executive summary (§ 68.155);
- The registration for the facility (§ 68.160);
- The certification statement (§ 68.185);
- A worst-case scenario analysis for each Program 1 process; at least one worst-case scenario analysis to cover all Program 2 and 3 processes involving regulated toxic substances; at least one worst-case scenario analysis to cover all Program 2 and 3 processes involving regulated flammables (§ 68.165(a));
- The five-year accident history for each process (§ 68.168); and
- Information concerning emergency response at the facility (§ 68.180).

Any facility with at least one covered process in Program 2 or 3 must also include:

- At least one alternative release scenario analysis for each regulated toxic substance in Program 2 or 3 processes and at least one alternative release scenario analysis to cover all regulated flammables in Program 2 or 3 processes (§ 68.165(b));
- A summary of the prevention program for each Program 2 process (§ 68.170); and
- A summary of the prevention program for each Program 3 process (§ 68.175).

The Risk Management Plans are submitted every 5 years to US authorities or when significant changes occur at the facility (*e.g.*, an accident occurs, etc.).

g. Preparedness Planning

Goal

All enterprises have appropriate on-site preparedness planning to mitigate adverse effects of chemical accidents, and cooperate with authorities in their off-site planning efforts.

Why

It is not possible to totally eliminate the chance of chemical accidents at hazardous installations and, therefore, it is important to prepare for any accidents that might occur to minimise adverse effects.

Owners/operators are responsible for preparedness planning for possible accidents, and for addressing possible impacts within the boundaries of the installation (on-site plans), and for providing the information needed by authorities to develop off-site plans.

Additional information is provided in Chapter C, Section C3, part (d) (Preparedness Planning) on page 75 and SG-3 (Guidance on Emergency Planning) on page 126.

How

- Require owners/operators of hazardous installations to develop on-site plans, based on an identification and assessment of potential risks, and an elaboration of possible accident scenarios.
  - Emergency planning should reflect a realistic assessment of the existing skills, equipment, and other resources that are available for the response effort, and an assessment of the skills, equipment, and other resources required based on a range of possible scenarios.
  - Emergency planning should take into account potential complicating factors that could make response more difficult (such as extreme weather conditions, natural disasters, loss of power or water supplies, trouble with communication and transportation systems, domino effects).
  - Emergency planning should allow for flexible response to a range of possible situations (from small accidents to worst-case scenarios).
  - Emergency plan should identify the roles and responsibilities of all parties concerned and describe the chain of command and lines of communication.
- Require owners/operators to provide public authorities with the information needed to develop off-site plans.
- Ensure integration and coordination of on-site and off-site plans.
- Regularly test and review the plans so that they are kept up-to-date.

Pitfalls

- Creating emergency plans that are put on the shelf and not considered until an emergency takes place.
- Outdated emergency plans because of changes in the risks, resources, or personnel involved. It is important emergency plans are kept up-to-date, taking into account developments (new risks, changes in resources, population shifts, etc.), as well as experience gained in response and in testing.
- Responders are not properly trained: there needs to be regular review, training, and exercises so all involved know their responsibilities and they don't forget or become complacent.
- Emergency plans that present an ideal, rather than a realistic, assessment of risks and resources (including manpower).
- Failure to take into account the fact an accident may occur during non-working hours, and/or under bad weather conditions.
- Failure to recognise that accidents can destroy communication centres and other response facilities.
- Failure to know when to call for external response assistance.

Excerpts from International Instruments

ILO CONVENTION

ARRANGEMENTS AT THE LEVEL OF THE INSTALLATION

Article 9

In respect of each major hazard installation employers shall establish and maintain a documented system of major hazard control which includes provision for:

...

d. emergency plans and procedures, including:

i. the preparation of effective site emergency plans and procedures, including emergency medical procedures, to be applied in case of major accidents or threat thereof, with periodic testing and evaluation of their effectiveness and revision as necessary;

ii. the provision of information on potential accidents and site emergency plans to authorities and bodies responsible for the preparation of emergency plans and procedures for the protection of the public and the environment outside the site of the installation;

iii. any necessary consultation with such authorities and bodies;

e. measures to limit the consequences of a major accident.

Article 15

Taking into account the information provided by the employer, the competent authority shall ensure that emergency plans and procedures containing provisions for the protection of the public and the environment outside the site of each major hazard installation are established, updated at appropriate intervals and coordinated with the relevant authorities and bodies.

UNECE CONVENTION

Article 8: Emergency Preparedness

1. The Parties shall take appropriate measures to establish and maintain adequate emergency preparedness to respond to industrial accidents. The Parties shall ensure that preparedness measures are taken to mitigate transboundary effects of such accidents, on-site duties being undertaken by operators. These measures may include, but are not limited to those referred to in Annex VII hereto. In particular, the Parties concerned shall inform each other of their contingency plans.
2. The Party of origin shall ensure for hazardous activities the preparation and implementation of on-site contingency plans, including suitable measures for response and other measures to prevent and minimise transboundary effects. The Party of origin shall provide to the other Parties concerned the elements it has for the elaboration of contingency plans.
3. Each Party shall ensure for hazardous activities the preparation and implementation of off-site contingency plans covering measures to be taken within its territory to prevent and minimise transboundary effects. In preparing these plans, account shall be taken of the conclusions of analysis and evaluation, in particular the matters set out in Annex V, paragraph 2, subparagraphs (1) to (5). Parties concerned shall endeavour to make such plans compatible. Where appropriate, joint off-site contingency plans shall be drawn up in order to facilitate the adoption of adequate response measures.
4. Contingency plans should be reviewed regularly, or when circumstances so require, taking into account the experience gained in dealing with actual emergencies.

SEVESO II DIRECTIVE

Article 11: Emergency plans

1. Member States shall ensure that, for all establishments to which Article 9 applies:

a. the operator draws up an internal emergency plan for the measures to be taken inside the establishment,

– for new establishments, prior to commencing operation,

- for existing establishments not previously covered by Directive 82/501/EEC, three years from the date laid down in Article 24 (1),
- for other establishments, two years from the date laid down in Article 24 (1),
- for establishments which subsequently fall within the scope of this Directive, without delay, but at all events within one year after the date on which this Directive applies to the establishment concerned, as laid down in the first subparagraph of Article 2(1);

b. the operator supplies to the competent authorities, to enable the latter to draw up external emergency plans, the necessary information within the following periods of time:

- for new establishments, prior to the start of operation,
- for existing establishments not previously covered by Directive 82/501/EEC, three years from the date laid down in Article 24 (1),
- for other establishments, two years from the date laid down in Article 24 (1),
- for establishments which subsequently fall within the scope of this Directive, without delay, but at all events within one year after the date on which this Directive applies to the establishment concerned, as laid down in the first subparagraph of Article 2(1);

c. the authorities designated for that purpose by the Member State draw up an external emergency plan for the measures to be taken outside the establishment.

2. The emergency plans must be established with the objectives of:

- containing and controlling incidents so as to minimize the effects, and to limit damage to man, the environment and property,
- implementing the measures necessary to protect man and the environment from the effects of major accidents,
- communicating the necessary information to the public and to the services or authorities concerned in the area,
- providing for the restoration and clean-up of the environment following a major accident.

Emergency plans shall contain the information set out in Annex IV.

3. Without prejudice to the obligations of the competent authorities, Member States shall ensure that the internal emergency plans provided for in this Directive are drawn up in consultation with the personnel working inside the establishment, including long-term relevant subcontracted personnel, and that the public is consulted on external emergency plans when they are established or updated.

4. Member States shall ensure that internal and external emergency plans are reviewed, tested, and where necessary revised and updated by the operators and designated authorities at suitable intervals of no longer than three years. The review shall take into account changes occurring in the establishments concerned or within the emergency services concerned, new technical knowledge, and knowledge concerning the response to major accidents.

4a. With regard to external emergency plans, Member States should take into account the need to facilitate enhanced cooperation in civil protection assistance in major emergencies.

5. Member States shall ensure that emergency plans are put into effect without delay by the operator and, if necessary by the competent authority designated for this purpose:

- when a major accident occurs, or
- when an uncontrolled event occurs which by its nature could reasonably be expected to lead to a major accident.

6. The competent authority may decide, giving reasons for its decision, in view of the information contained in the safety report, that the requirement to produce an external emergency plan under paragraph 1 shall not apply.

Annex IV: Data and Information to be Included in the Emergency Plans Specified Under Article 11

1. Internal emergency plans

a. Names or positions of persons authorized to set emergency procedures in motion and the person in charge of and coordinating the on-site mitigatory action.

b. Name or position of the person with responsibility for liaising with the authority responsible for the external emergency plan.

c. For foreseeable conditions or events which could be significant in bringing about a major accident, a description of the

action which should be taken to control the conditions or events and to limit their consequences, including a description of the safety equipment and the resources available.

d. Arrangements for limiting the risks to persons on site including how warnings are to be given and the actions persons are expected to take on receipt of a warning.

e. Arrangements for providing early warning of the incident to the authority responsible for setting the external emergency plan in motion, the type of information which should be contained in an initial warning and the arrangements for the provision of more detailed information as it becomes available.

f. Arrangements for training staff in the duties they will be expected to perform, and where necessary coordinating this with off-site emergency services.

g. Arrangements for providing assistance with off-site mitigatory action.

2. External emergency plans

a. Names or positions of persons authorized to set emergency procedures in motion and of persons authorized to take charge of and coordinate off-site action.

b. Arrangements for receiving early warning of incidents, and alert and call-out procedures.

c. Arrangements for coordinating resources necessary to implement the external emergency plan.

d. Arrangements for providing assistance with on-site mitigatory action.

e. Arrangements for off-site mitigatory action.

f. Arrangements for providing the public with specific information relating to the accident and the behaviour which it should adopt.

g. Arrangements for the provision of information to the emergency services of other Member States in the event of a major accident with possible transboundary consequences.

US LAWS

Under the Clean Air Act, Risk Management Plan (RMP) Program, facilities are required to develop amd implement an emergency response program for the purpose of protecting public health and the environment. The emergency response program must include the following elements:

1. An emergency response plan, which shall be maintained at the stationary source and contain at least the following elements:

   i. Procedures for informing the public and local emergency response agencies about accidental releases;

   ii. Documentation of proper first-aid and emergency medical treatment necessary to treat accidental human exposures; and

   iii. Procedures and measures for emergency response after an accidental release of a regulated substance;

2. Procedures for the use of emergency response equipment and for its inspection, testing, and maintenance;

3. Training for all employees in relevant procedures; and

4. Procedures to review and update, as appropriate, the emergency response plan to reflect changes at the stationary source and ensure that employees are informed of changes.

In addition, a written plan that complies with other Federal contingency plan regulations and that, among other matters, includes the elements provided in paragraph (a) of this section, shall satisfy the requirements of this section if the owner or operator also complies with paragraph (c) of this section.

Finally, the emergency response plan developed under paragraph (1) of this section shall be coordinated with the community emergency response plan developed by the LEPC under the Emergency Planning and Community Right-to-know Act. Upon request of the local emergency planning committee or emergency response officials, the owner or operator shall promptly provide to the local emergency response officials information necessary for developing and implementing the community emergency response plan.

C5: Information to the Public

Goal

The potentially affected public is aware of the risks in their community and how to act in the event of an accident.

Why

Provision of information to the public is critical to mitigating adverse impacts off-site should an accident occur. This information will also help to build confidence in authorities and industry that they are managing risks.

How

- Identify the installations with the potential for accidents with off-site effects and define the related population at risk in the event of an accident, so that the information is targeted to the correct audience.
- Establish a system to communicate with the potentially affected public (which can be done by the industry, by public authorities, through third parties or through some combination of these). This information should identify what action to take following an accident, including guidance on how warnings and directions will be made available to the potentially affected public.
  - The information should be given without request and be repeated periodically.
  - The information needs to be in a language and a form that can be understood by the target audience (taking into account, for example, language/culture, educational background, etc.). In this regard, the information should be comprehensible to individuals without technical knowledge and training.
  - The information needs to be realistic (*e.g.*, that the systems for warning the public in the event of an accident are the same as those described in the information provided to the public).
  - Several channels should be used to circulate information, choosing those that are appropriate for the community (*e.g.*, in the newspapers, on the television/radio, in materials provided to school children, in mailers in utility or telephone bills, at town meetings, at churches, etc.).
- Assign the responsibility for communication with the public to individuals with appropriate knowledge and skills and who are credible.
- Ensure that the information to be provided to the public is consistent with the emergency planning strategies (this may require consultation with the authorities responsible for emergency response / civil protection).
- Periodically test the effectiveness of the communication scheme to increase the likelihood that the information is reaching the right audience and that they are retaining the information.
- Provide information to the media so that they have the necessary background to be an effective source of information should an accident occur.
- Establish means for the public to communicate with authorities and industry.
- Include the public across borders if there is a risk of an accident with transboundary effects.

Additional information is provided in Text Box 15 (Information to be Communicated to the Public) on page 111.

Pitfalls

- The information doesn't reach the target audience. It is difficult to find channels of communication that are effective in reaching the target audience in a way that they will pay attention to the information.
- A complacent public. The public tends to get complacent if there hasn't been an accident, or a threat of an accident, in a while. Therefore, it is necessary to reinforce the information on a routine basis using different channels.
- Failure of the public to follow instructions when an accident occurs.
- The likelihood and extent of off-site impacts are underestimated by the owners/operators.

Text Box 15

INFORMATION TO BE COMMUNICATED TO THE PUBLIC

The following is a list of the information that should be communicated to the public concerning hazardous installations, based on the Seveso II Directive:

1. Name of operator and address of the hazardous installation.
2. Identification, by position held, of the person giving the information.
3. An explanation in simple terms of the activity or activities undertaken at the establishment.
4. The common names, the generic names or the general danger classification of the hazardous substances involved at the installation establishment which could give rise to a accident, with an indication of their principal dangerous characteristics.
5. General information relating to the nature of the accident hazards, including their potential effects on the health, the environment, or property.
6. Adequate information on how the population concerned will be warned and kept informed in the event of a major accident.
7. Adequate information on the actions the population concerned should take, and on the behaviour they should adopt, in the event of a major accident.
8. Confirmation that the operator is required to make adequate arrangements on site, in particular liaison with the emergency services, to deal with major accidents and to minimise their effects.
9. A reference to the external emergency plan drawn up to cope with any off-site effects from an accident. This should include advice to cooperate with any instructions or requests from the emergency services at the time of an accident.
10. Details of where further relevant information can be obtained, subject to the requirements of confidentiality laid down in national legislation.

Excerpts from International Instruments

ILO CONVENTION

Article 16

The competent authority shall ensure that:

a. information on safety measures and the correct behaviour to adopt in the case of a major accident is disseminated to members of the public liable to be affected by a major accident without their having to request it and that such information is updated and redisseminated at appropriate intervals;

b. warning is given as soon as possible in the case of a major accident;

c. where a major accident could have transboundary effects, the information required in (a) and (b) above is provided to the States concerned, to assist in cooperation and coordination arrangements.

UNECE CONVENTION

Article 9: Information to, and Participation of the Public

1. The Parties shall ensure that adequate information is given to the public in the areas capable of being affected by an industrial accident arising out of a hazardous activity. This information shall be transmitted through such channels as the Parties deem appropriate, shall include the elements contained in Annex VIII hereto and should take into account matters set out in Annex V, paragraph 2, subparagraphs (1) to (4) and (9).

2. The Party of origin shall, in accordance with the provisions of this Convention and whenever possible and appropriate, give the public in the areas capable of being affected an opportunity to participate in relevant procedures with the aim of making known its views and concerns on prevention and preparedness measures, and shall ensure that the opportunity given to the public of the affected Party is equivalent to that given to the public of the Party of origin.

UNECE Convention *(continued)*

3. The Parties shall, in accordance with their legal systems and, if desired, on a reciprocal basis provide natural or legal persons who are being or are capable of being adversely affected by the transboundary effects of an industrial accident in the territory of a Party, with access to, and treatment in the relevant administrative and judicial proceedings, including the possibilities of starting a legal action and appealing a decision affecting their rights, equivalent to those available to persons within their own jurisdiction.

Annex VIII: Information to the Public Pursuant to Article 9

1. The name of the company, address of the hazardous activity and identification by position held of the person giving the information;
2. An explanation in simple terms of the hazardous activity, including the risks;
3. The common names or the generic names or the general danger classification of the substances and preparations which are involved in the hazardous activity, with an indication of their principal dangerous characteristics;
4. General information resulting from an environmental impact assessment, if available and relevant;
5. The general information relating to the nature of an industrial accident that could possibly occur in the hazardous activity, including its potential effects on the population and the environment;
6. Adequate information on how the affected population will be warned and kept informed in the event of an industrial accident;
7. Adequate information on the actions the affected population should take and on the behaviour they should adopt in the event of an industrial accident;
8. Adequate information on arrangements made regarding the hazardous activity, including liaison with the emergency services, to deal with industrial accidents, to reduce the severity of the industrial accidents and to mitigate their effects;
9. General information on the emergency services' off-site contingency plan, drawn up to cope with any off-site effects, including the transboundary effects of an industrial accident;
10. General information on special requirements and conditions to which the hazardous activity is subject according to the relevant national regulations and/or administrative provisions, including licensing or authorization systems;
11. Details of where further relevant information can be obtained.

SEVESO II DIRECTIVE

Article 13: Information on safety measures

1. Member States shall ensure that information on safety measures and on the requisite behaviour in the event of an accident is supplied regularly and in the most appropriate form, without their having to request it, to all persons and all establishments serving the public (such as schools and hospitals) liable to be affected by a major accident originating in an establishment covered by Article 9.

   The information shall be reviewed every three years and, where necessary, repeated and updated, at least if there is any modification within the meaning of Article 10. It shall also be made permanently available to the public. The maximum period between the repetition of the information to the public shall, in any case, be no longer than five years.

   Such information shall contain, at least, the information listed in Annex V.
2. Member States shall, with respect to the possibility of a major accident with transboundary effects originating in an establishment under Article 9, provide sufficient information to the potentially affected Member States so that all relevant provisions contained in Articles 11, 12 and this Article can be applied, where applicable, by the affected Member State.
3. Where the Member State concerned has decided that an establishment close to the territory of another Member State is incapable of creating a major-accident hazard beyond its boundary for the purposes of Article 11 (6) and is not therefore required to produce an external emergency plan under Article 11 (1), it shall so inform the other Member State.
4. Member States shall ensure that the safety report is made available to the public. The operator may ask the competent authority not to disclose to the public certain parts of the report, for reasons of industrial, commercial or personal confidentiality, public security or national defence. In such cases, on the approval of the competent authority, the operator shall supply to the authority, and make available to the public, an amended report excluding those matters.

Seveso II Directive *(continued)*

5. Member States shall ensure that the public is able to give its opinion in the following cases:
   - planning for new establishments covered by Article 9,
   - modifications to existing establishments under Article 10, where such modifications are subject to obligations provided for in this Directive as to planning,
   - developments around such existing establishments.
6. In the case of establishments subject to the provisions of Article 9, Member States shall ensure that the inventory of dangerous substances provided for in Article 9(2) is made available to the public subject to the provisions of paragraph 4 of this Article and Article 20.

Annex V: Items of Information to be Communicated to the Public as Provided for in Article 13 (1)

1. Name of operator and address of the establishment.
2. Identification, by position held, of the person giving the information.
3. Confirmation that the establishment is subject to the regulations and/or administrative provisions implementing this Directive and that the notification referred to in Article 6 (3) or the safety report referred to in Article 9 (1) has been submitted to the competent authority.
4. An explanation in simple terms of the activity or activities undertaken at the establishment.
5. The common names or, in the case of dangerous substances covered by Part 2 of Annex 1, the generic names or the general danger classification of the substances and preparations involved at the establishment which could give rise to a major accident, with an indication of their principal dangerous characteristics.
6. General information relating to the nature of the major-accident hazards, including their potential effects on the population and the environment.
7. Adequate information on how the population concerned will be warned and kept informed in the event of a major accident.
8. Adequate information on the actions the population concerned should take, and on the behaviour they should adopt, in the event of a major accident.
9. Confirmation that the operator is required to make adequate arrangements on site, in particular liaison with the emergency services, to deal with major accidents and to minimize their effects.
10. A reference to the external emergency plan drawn up to cope with any off-site effects from an accident. This should include advice to cooperate with any instructions or requests from the emergency services at the time of an accident.
11. Details of where further relevant information can be obtained, subject to the requirements of confidentiality laid down in national legislation.

US LAWS

Emergency Planning and Community Right-to-Know Act (EPCRA) (42 USC 116)

Under the Community Right-to-Know aspects of the EPCRA,owners and operators of certain facilities are required to provide detailed information on the chemicals present at their facilities to several state and local organizations. These organizations include the State Emergency Response Commission (SERC), the Local Emergency Planning Committee (LEPC) and the local fire department. In addition, these facilities are required to report to EPA every year any routine toxic chemical emissions from their facilities into the environment. EPA maintains the Toxic Release Inventory (TRI) Program based on this information.

As part of the Community Right-to-Know provisions of EPCRA, the public has the right to access any of this information. Public access to detailed information on chemicals present in their communities is available during normal working hours from the LEPC or the SERC. In order to inform the public of the availability and location of this information, the LEPC publishes a notice annually in local newspapers. In addition, EPA releases a printed report each year summarizing the information that was submitted for the annual TRI, which is available online.

These requirements are designed to help citizens gain a better understanding of the hazards that are present in their communities and to improve their locality's response capabilities through better coordination and planning.

C6: Accident Reporting, Investigation, and Follow-up

Goal

To understand the root and contributing causes of accidents and learn lessons from accidents to improve prevention, preparedness, and response.

Why

Using the information learned from a review of accident reports and accident investigations can help to prevent similar accidents from taking place in the future.

Accident reports and investigations provide insights for setting priorities for government and industry actions.

Learning from experience helps to build public confidence that proper steps are being taken to avoid future consequences.

How

- Mandate prompt reporting to an appropriate authority of accidents and significant near-misses that meet specified criteria. It is preferable to use a standardised form, to allow for systematic collection and review of information.
  - Maintain a national register of accident reports and statistics, and undertake appropriate reviews of accidents. Accident reports can be supplemented with other information available to the authorities such as health and hospital records.[32]
  - Clarify which accidents / near misses are subject to the reporting requirement.
  - Describe the information that should be reported (*e.g.*, the type and amount of hazardous substances released, the installation involved, an accident description, the consequences to health, environment, or property, the causes of the accident, the emergency response actions taken).
  - Analyse the accident reports to identify trends and lessons learned.
- Require that owners/operators investigate accidents that meet specified criteria to determine root and contributing causes (including possible technical, organisational and managerial aspects), and identify lessons learned.
- Authorities investigate key accidents with the potential for identifying important lessons, following established protocols.
  - Ensure that adequate resources (including trained personnel) are available to do this.
  - Involve all appropriate government authorities and non-governmental organisations in the investigation, and coordinate among authorities.
- Recognise that causes of accidents can be many, complex and inter-related. Management practices, worker skills and knowledge, training, operating policies and procedures, equipment, technical processes, government regulations, and external factors may all play a role.
- Promote the sharing of information about accidents and investigations and the application of lessons learned.
  - Investigation reports prepared by government authorities should be published and disseminated as widely as possible within the country and between countries (with modifications to protect confidential business information). Many countries post their reports on their websites.[33] Examples are provided in Section (c) of Annex VI (Selected Bibliography – Accident Reports and Case Studies) on page 176.

[32]The International Programme on Chemical Safety has created tools to help countries manage health-related information. See: http://www.who.int/ipcs/emergencies/en/.

[33]The US Chemical Safety and Hazard Investigation Board (CSB) has prepared a series of safety videos based on lessons learned from investigations which are publicly available and, in some cases, translated into other languages which can be found at: http://www.chemsafety.gov/.

- Participate in local, regional and international initiatives for the exchange of accident histories among governments and among enterprises (*e.g.*, through industry associations).

Additional information is provided in SG-6 (Guidance on Accident Investigations) on page 134.

Pitfalls

- Difficulty in enforcing reporting requirements, especially if there were no off-site effects.
- Ensuring that the focus of investigations is on identifying root and contributing causes, not on assessing blame.
- Not sharing the lessons learned. (Sharing experience is necessary to prevent similar accidents in the future). It should be recognised that information sharing schemes should protect confidential business information.

Excerpts from International Instruments

ILO CONVENTION

Article 13

Employers shall inform the competent authority and other bodies designated for this purpose as soon as a major accident occurs.

Article 14

1. Employers shall, within a fixed time-frame after a major accident, present a detailed report to the competent authority containing an analysis of the causes of the accident and describing its immediate on-site consequences, and any action taken to mitigate its effects.
2. The report shall include recommendations detailing actions to be taken to prevent a recurrence.

UNECE CONVENTION

Article 10: Industrial Accident Notification Systems

1. The Parties shall, with the aim of obtaining and transmitting industrial accident notifications containing information needed to counteract transboundary effects, provide for the establishment and operation of compatible and efficient industrial accident notification systems at appropriate levels.
2. In the event of an industrial accident, or imminent threat thereof, which causes or is capable of causing transboundary effects, the Party of origin shall ensure that affected Parties are, without delay, notified at appropriate levels through the industrial accident notification systems. Such notification shall include the elements contained in Annex IX hereto.
3. The Parties concerned shall ensure that, in the event of an industrial accident or imminent threat thereof, the contingency plans prepared in accordance with Article 8 are activated as soon as possible and to the extent appropriate to the circumstances.

SEVESO II DIRECTIVE

Article 14: Information to be supplied by the operator following a major accident

1. Member States shall ensure that, as soon as practicable following a major accident, the operator shall be required, using the most appropriate means:

   a. to inform the competent authorities;

   b. to provide them with the following information as soon as it becomes available:

   – the circumstances of the accident,

Seveso II Directive *(continued)*

- the dangerous substances involved,
- the data available for assessing the effects of the accident on man and the environment; and
- the emergency measures taken;

c. to inform them of the steps envisaged:

- to alleviate the medium- and long-term effects of the accident,
- to prevent any recurrence of such an accident; and

d. to update the information provided if further investigation reveals additional facts which alter that information or the conclusions drawn.

2. Member States shall require the competent authority:

a. to ensure that any urgent, medium- and long-term measures which may prove necessary are taken;

b. to collect, by inspection, investigation or other appropriate means, the information necessary for a full analysis of the technical, organizational and managerial aspects of the major accident;

c. to take appropriate action to ensure that the operator takes any necessary remedial measures; and

d. to make recommendations on future preventive measures.

US LAWS

Regulated facilities must report discharges of oil or releases of hazardous substances to EPA, other federal agencies, and/or state and local government agencies.

The federal government has established Reportable Quantities (RQs) for listed hazardous substances. If a hazardous substance is released to the environment in an amount that equals or exceeds its RQ, the release must be reported to National Response Center, which is the federal authorities responsible for collecting and storing reports on chemical and oil releases.

Additionally, under the Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986, the owner or operator of a facility that releases a hazardous substance equal to or in excess of its RQ or an extremely hazardous substance in an amount greater than its established RQ must report that release to the appropriate authorities (in many cases, the State Emergency Response Commission (SERC) and the Local Emergency Planning Committee (LEPC)) for the location where the incident occurs.

Finally, under the Clean Air Act's Risk Management Plan (RMP) Program, facilities must include in their RMP a five-year accident history of all accidental releases from covered processes that resulted in deaths, injuries, or significant property damage on site, or known offsite deaths, injuries, evacuations, sheltering in place, property damage, or environmental damage. Releases from non-covered processes, even if they involved regulated substances, or releases of non-listed substances from covered processes, are not included.

For each accidental release reported in the accident history section of the RMP, facilities report standard descriptive information, as well as some new information such as the weather conditions, on-site and known offsite impacts, the initiating event and contributing factors, whether offsite responders were notified, and any changes made at the facility as a result of the accident.

Regarding accident investigation, the RMP Program requirements state that owners or operators must investigate each incident which resulted in, or could have resulted in a catastrophic release. This incident investigation must be initiated not later than 48 hours after the accident occurs and a summary must be prepared at the conclusion of the investigation. This summary should include: the date of the incident, the date the investigation began, a description of the incident, the factors that contributed to the incident, and any recommendations resulting from the investigation. The owner or operator shall promptly address and resolve the investigation findings and those resolutions shall be documented. Additionally, the findings shall be reviewed with all affected personnel whose job tasks are affected by the findings.

In addition to the RMP requirements for owners and operators to investigate accidents at their facility, the Clean Air Act Section 112(r) required the establishment of a Chemical Safety Board (CSB) whose principal role is to investigate accidents to determine the conditions and circumstances which led up to the event and to identify the cause or causes so that similar events might be prevented. More information about the CSB and its investigations can be found at: www.csb.gov.

SG-1: Guidance on Safety Management Systems

From: Major Accidents Hazards Bureau (EC), Guidelines on a Major Accident Prevention Policy and Safety Management System, as Required by Council Directive 96/82/EC (Seveso II) (http://mahbsrv.jrc.it/downloads-pdf/smsf.pdf)[34]

Described below are the seven elements of safety management systems, as set out in the EC Guidelines:

1. organisation and personnel;
2. hazard identification and evaluation;
3. occupational control;
4. management of change;
5. planning for emergencies;
6. monitoring performance; and
7. audit and review.

Organisation and Personnel

Relevant text from the Directive:

The following issues shall be addressed by the safety management system:

Organisation and Personnel – the roles and responsibilities of personnel involved in the management of major hazards at all levels in the organisation. The identification of training needs of such personnel and the provision of the training so identified. The involvement of employees and, where appropriate, sub-contractors.

The Safety Management System should reflect the top-down commitment and the safety culture of the operator's organisation, translated into the necessary resources and direct responsibilities of personnel involved in the management of major hazards at all levels in the organisation. The operator should identify the skills and abilities needed by such personnel, and ensure their provision.

The role, responsibility, accountability, authority and interrelation of all personnel who manage, perform or verify work affecting safety should be defined, particularly for staff responsible for:

- the provision of resources, including human resources, for SMS development and implementation;
- action to ensure staff awareness of hazards, and compliance with the operator's safety policy;
- identification, recording and follow-up of corrective or improvement actions;
- control of abnormal situations, including emergencies;
- identifying training needs, provision of training, and evaluation of its effectiveness; and
- coordinating the implementation of the system and reporting to top management.

The operator should ensure the involvement of employees, and where appropriate of contractors or others present at the establishment, both in determining the safety policy and in its implementation. In particular the operator should ensure that contractors receive the necessary information and training to enable them to be aware of the hazards involved, and to satisfy the safety policy.

[34]At the time of writing, the EC MAHB was in the process of updating their website and some internet addresses in this document may change. After the website is fully updated, the Safety Management System Guidelines will be available at: http://mahb.jrc.ec.europa.eu/index.php?id=55.

Hazard Identification and Evaluation

Relevant text from the Directive:

The following issues shall be addressed by the safety management system:

Identification and Evaluation of Major Hazards – adoption and implementation of procedures for systematically identifying major hazards arising from normal and abnormal operation and the assessment of their likelihood and severity.

The operator should develop and implement procedures to systematically identify and evaluate hazards arising from its activities, and from the substances and materials handled or produced in them. The procedures used for the identification and evaluation of hazards should be formal, systematic, and critical. There should also be systematic procedures for the definition of measures both for the prevention of incidents and for the mitigation of their consequences.

The detailed content of procedures for hazard identification and evaluation is beyond the scope of this particular guidance document. However the 'management system' should include an assessment of the skills and knowledge required, including where appropriate a team approach in order to find the necessary combination and range of theoretical and practical knowledge to develop and implement appropriate procedures.

Hazard identification and evaluation procedures should be applied to all relevant stages from project conception through to decommissioning, including:

- potential hazards arising from or identified in the course of planning, design, engineering, construction, commissioning, and development activities;
- the normal range of process operating conditions, hazards of routine operations and of non-routine situations, in particular start-up, maintenance, and shut-down;
- incidents and possible emergencies, including those arising from component or material failures, external events, and human factors, including failures in the SMS itself;
- hazards of decommissioning, abandonment, and disposal;
- potential hazards from former activities; and
- external hazards including those arising from natural hazards (including abnormal temperatures, fire, flood, earthquake, strong winds, tidal waves), from transport operations including loading and unloading, from neighbouring activities, and from malevolent or unauthorised action.

Due consideration should be given to any lessons learnt from previous incidents and accidents (both within and outside the organisation concerned), from operating experience of the installation concerned or similar ones, and from previous safety inspections and audits.

Operational Control

Relevant text from the Directive:

The following issues shall be addressed by the safety management system:

Operational Control – adoption and implementation of procedures and instructions for safe operation, including maintenance, of plant, processes, equipment and temporary stoppages.

The operator should prepare and keep up to date and readily available the information on process hazards and design and operational limits and controls coming from the hazard identification and risk evaluation procedures. Based on these, documented procedures should be prepared and implemented to ensure safe design and operation of plant, processes, equipment and storage facilities. In particular, these procedures should cover:

- commissioning;
- start-up and normal periodic shutdown;
- all phases of normal operations, including test, maintenance, and inspection;
- detection of and response to departures from normal operating conditions;
- temporary or special operations;
- operation under maintenance conditions;
- emergency operations; and
- decommissioning.

Safe working practices should be defined for all activities relevant for operational safety.

Procedures, instructions and methods of work should be developed in cooperation with the people who are required to follow them, and should be expressed in a form understandable to them. The operator should ensure these procedures are implemented and provide the training necessary.

These written procedures should be made available to all staff responsible directly or indirectly for operation, and where appropriate to others involved such as maintenance staff. They should also be subject to periodic review both to ensure that they are current and accurate, and to ensure that they are actually followed.

Management of Change

Relevant text from the Directive:

The following issues shall be addressed by the safety management system:

Management of Change – adoption and implementation of procedures for planning modifications to, or the design of new installations, processes or storage facilities.

The operator should adopt and implement management procedures for planning and controlling all changes in people, plant, processes and process variables, materials, equipment, procedures, software, design or external circumstances which are capable of affecting the control of major accident hazards. This approach should cover permanent, temporary and urgent operational changes, and should address:

- definition of what constitutes a change;
- assignment of responsibilities and authorities for initiating change;
- identification and documentation of the change proposed and of its implementation;
- identification and analysis where appropriate of any safety implications of the change proposed;
- definition, explanation where appropriate, documentation, and implementation of the safety measures deemed appropriate, including information and training requirements, as well as the necessary changes to operational procedures; and
- definition and implementation of appropriate post-change review procedures and corrective mechanisms, and subsequent monitoring.

Management of change procedures must also be applied during the design and construction of new installations, processes, and storage facilities.

Planning for Emergencies

Relevant text from the Directive:

The following issues shall be addressed by the safety management system:

Planning for Emergencies – adoption and implementation of procedures to identify foreseeable emergencies by systematic analysis and to prepare, test and review emergency plans to respond to such emergencies.

The detailed content of the emergency plan is not within the scope of this particular guidance document. (Details of data and information to be included in an Emergency Plan are specified in Annex IV of the Directive.)

However the Safety Management System does include the procedures necessary to ensure that an adequate emergency plan is developed, adopted, implemented, reviewed, tested, and where necessary revised and updated. These procedures will define the skills and abilities required, including where appropriate a team approach in order to find the necessary combination of theoretical and practical knowledge. The operator should develop and maintain procedures to identify, by systematic analysis starting from the hazard identification process, foreseeable emergencies arising from or in connection with its activities, and to record and keep up to date the results of this analysis. Plans to respond to such potential emergencies should be prepared, and arrangements for testing and review on a regular basis should be included within the Safety Management System. The procedures should also cover the necessary arrangements for communication of the plans to all those likely to be affected by an emergency.

Monitoring Performance

Relevant text from the Directive:

The following issues shall be addressed by the safety management system:

Monitoring Performance – adoption and implementation of procedures for the ongoing assessment of compliance with the objectives set by the operator's major accident prevention policy and safety management system, and the mechanisms for investigation and taking corrective action in case of non-compliance. The procedures should cover the operator's system for reporting major accidents or near misses, particularly those involving failure of protective measures, and their investigation and follow-up on the basis of lessons learnt.

The operator should maintain procedures to ensure that safety performance can be monitored and compared with the safety objectives defined. This should include determining whether plans and objectives are being achieved, and whether arrangements to control risks are being implemented before an incident or accident occurs (active monitoring), as well as the reporting and investigation of failures which have resulted in incidents or accidents (reactive monitoring).

Active monitoring should include inspections of safety critical plant, equipment and instrumentation as well as assessment of compliance with training, instructions and safe working practices.

Reactive monitoring requires an effective system for reporting incidents and accidents and an investigation system which identifies not only the immediate causes but also any underlying failures which led to the event. It should pay particular attention to cases of failure of protective measures (including operational and management failures), and should include investigation, analysis, and follow-up (including transfer of information to personnel involved) to ensure that the lessons learnt are applied to future operation.

The operator should define the responsibility for initiating investigation and corrective action in the event of non-compliance with any part of the SMS. This should include in particular revision where necessary of procedures or systems to prevent recurrence. The information from performance monitoring should also be a significant input to the processes of audit and review (see below).

Audit and Review

Relevant text from the Directive:

The following issues shall be addressed by the safety management system:

Audit and Review – adoption and implementation of procedures for periodic systematic assessment of the major accident prevention policy and the effectiveness and suitability of the safety management system; the documented review of performance of the policy and safety management system and its up-dating by senior management.

The terms "audit" and "review" are used here for two different activities. An audit is intended to ensure that the organisation, processes, and procedures as defined and as actually carried out are consistent with the Safety Management System; it should be carried out by people who are sufficiently independent from the operational management of the unit being audited to ensure that their assessment is objective. A review is a more fundamental study of whether the Safety Management System is appropriate to fulfil the operator's policy and objectives, and may extend to considering whether the policy and objectives should themselves be modified.

Audit

In addition to the routine monitoring of performance, the operator should carry out periodic audits of its SMS as a normal part of its business activities. An audit should determine whether the overall performance of the Safety Management System conforms to requirements, both external and those of the operator. The results of these audits should be used to decide what improvements should be made to the elements of the SMS and their implementation.

For this purpose the operator should adopt and implement an audit plan covering items 1-6. This plan, which should be reviewed at appropriate intervals, should define:

- the areas and activities to be audited;
- the frequency of audits for each area concerned;
- the responsibility for each audit;

- the resources and personnel required for each audit, bearing in mind the need for expertise, operational independence, and technical support;
- the audit protocols to be used (which can include questionnaires, checklists, interviews both open and structured, measurements and observations);
- the procedures for reporting audit findings; and
- the follow-up procedures.

Review

Senior management should, at appropriate intervals, review the operator's overall safety policy and strategy for the control of major-accident hazards, and all aspects of the SMS to ensure its consistency with these. This review should also address the allocation of resources for SMS implementation, and should consider changes in the organisation as well as those in technology, standards, and legislation.

SG-2: Guidance on Risk Assessment

Risk assessment, in this context, is a tool used in risk management to help understand risks and inform the selection and prioritisation of prevention and control strategies. With risk assessment, risks can be ranked on a relative scale and technical/organisational/policy options can be evaluated, so that results can be maximised in terms of increased safety. This helps in the choice of options.

Risk assessment also provides information to policymakers to help them develop risk acceptability or tolerability criteria against which different objectives or programmes can be assessed.

Risk assessment is a process that consists of a number of sequential steps, *e.g.*, hazard identification, event scenario assessment, consequence assessment, likelihood assessment, and risk integration and comparison.

Owners/operators should undertake hazard identification and risk assessment for all hazardous installations. When undertaking a risk assessment, it is important to carefully consider the various possible approaches and methods available, and choose an approach/method that is appropriate for the particular circumstances, since all approaches/methods have strengths and weaknesses and none is perfect.

The choice of a particular approach/method should be governed by a number of factors, including:

- the objective/purpose of the risk assessment;
- the estimated nature of the risk;
- the availability and adequacy of data;
- the expertise and resources needed for a particular approach/method, and their availability;
- the history of incidents at the installation and other related installations;
- unavoidable constraints on the process;
- the socio-political context in which the assessment will be carried out; and
- the assumptions on which the approach/method is based.

Risk assessments should be accompanied by information concerning the assumptions, data limitations and uncertainties imbedded in risk assessment approaches/methods, as well as in decision-making processes, so that the results of risk assessments can be understood and appropriately utilised.

It is important to address possible data limitations and inappropriate selection of data in order for the results of the assessments to be reliable and comprehensive. For example, there may be gaps and inadequacies in the data available on equipment failure rates and modes, human error predictions, long-term or delayed health effects of acute exposures, the effects of chemicals on the environment, etc.

Data limitations can be managed, in part, through the use of less detailed, more generic approaches/methods, or the use of comparative assessments to aid in choosing among alternatives options. The use of comparative assessments normally involves similar assumptions, limitations, and uncertainties and therefore their effect on the assessment results is dissipated.

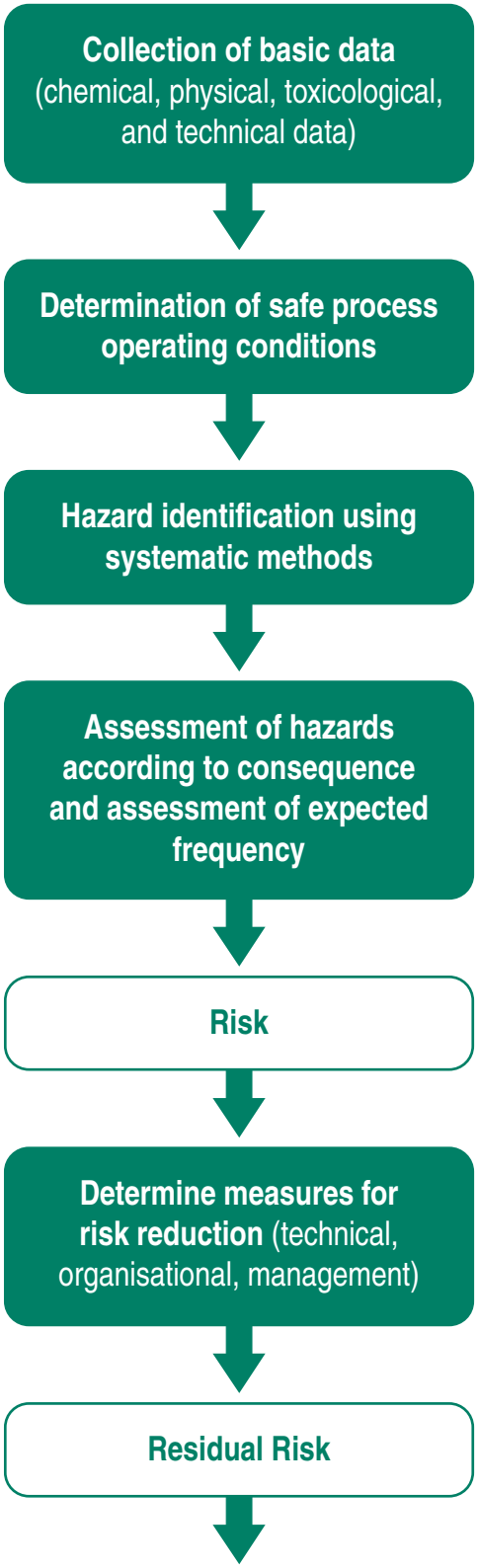
Risk assessment should be a continuous and evolving process. Assessments should be reviewed and reassessed periodically, and when there are indications that a revision may be needed. A risk assessment may need to be revisited when, for example:

- there are new or changed processes at hazardous installations, or significant changes in transport of hazardous substances;
- incidents occur;
- there are organisational changes;
- new technology offers scope for improvements;
- the experience of workers and/or management differs from the risk assessment;
- new information about the behaviour or effects of substances and processes becomes available; and
- there are proposals for new construction or other developments inside the premises of the installation or nearby.

Set out on the following page is a flow chart describing the sequential steps of risk assessments, followed by a description of risk assessment methods.

Systematic Hazard Identification and Risk Assessment

Hazard identification and risk assessment are two major elements of the risk management process. They are necessary to be able to make decisions relating to risk, *e.g.*, the avoidance, reduction, or transfer of a risk or acceptance of the residual risk.



Within the risk management process, it is necessary to carry out investigations with regard to the hazards. Of particular interest are the source of the hazard, the possibility of a negative effect (damage), together with the expected frequency or likelihood of the occurrence of a negative event and the extent of the damage.

The methodology used for these processes is known as risk analysis or risk assessments. The spectrum of specific methods is broad and covers various degrees of depth and complexity in the analysis as well as various systems of investigation. Some methods are quantitative, using numeric calculations, while others are qualitative in nature.

Risk Assessment Methods

The following discusses some of the risk assessment methods which are generally used in the chemical process industry. Over time, variations of these methods have evolved to fulfil the requirements of specific operators or groups of users.

The methods applied must show a systematic and plausible approach. Generally one method alone is not used for all the steps from hazard identification, through identifying the initiating event criteria to the determination of the effects and consequences. The various methods have different underlying principles by which they function and, therefore, have different uses.

1. Hazard Mapping

One of the simplest methods of hazard assessment is hazard mapping, in which a plan of the facility (or community) is used as a basis for documenting the amount and type of hazardous chemicals present based on their locations. In doing so, an overview of the distribution respective to the concentration of the hazardous substances can be obtained and an initial assessment made.

This method does not consider the technologies and processes related to the hazardous substances or the frequencies of occurrence of any release scenarios. herefore, this method is unable to provide any indication of the risks due to the hazardous substances.

2. Check-lists

Check-lists are used to check the completeness of particular operations, *e.g.*, deliveries, compliance with particular regulations, measures to be carried out (for example, regular maintenance or application of management of change processes), etc. When using check-lists it is important to be aware of their limits. Check-lists can only test what is already known. Consequences of changes or dynamic situations cannot be recognised or assessed. Usually the questions of a check-list are answered with a yes/no answer which also limits the depth which any investigation may reach.

Check-lists must first of all be developed; they should be as specific as possible for the task concerned,otherwise the necessary depth of enquiry is lost. One major weakness of check-lists is that they can lead to a narrow view of the situation and aspects beyond the questions posed may not be considered.

3. Hazard and Operability Study – HAZOP

The HAZOP process is a systematic approach for the discovery of deviations and hazards in systems of all types. It is a method which has become well established within the chemical processing industry. The HAZOP study is carried out in a team made up of the various departments concerned with the project or installation to be assessed (*e.g.*, planning, operating, maintenance, safety). The system to be examined is first of all divided into functional sections which are easily handled. Following this the intended function (operation) for the first section is described.

For example: *pump a total of 20 m³ of substance A at 20 °C with a flow rate of 3m³/h and a maximum pressure of 3 bar from the storage tank into the reactor.*

The core element of the HAZOP study is then the successive application of "Guidance words" to the intended operation to develop hypothetical deviations. The "Guidance words" are:

- no (not, none);
- more;
- less;
- partially;
- as well as;
- reverse; and
- other than.

Aspects of the operation which may be considered can be, for example: temperature, pressure, level, chemical identity, flow rate, volume, density, material, etc.

Following the development of the hypothetical deviations, those which are realistic events are investigated as to their causes and the consequences of their occurrence. This process is repeated for all of the functional sections to be examined. Measures for removing the hazards or reducing their impact are then determined.

The particular advantages of using HAZOP studies lie in the systematic approach and the diversity of failures and deviations within the chemical processes which can be covered. The major disadvantage is the time and documentation requirements. In particular, training and experience for the HAZOP team leader are important to ensure that the study does not get lost in fine detail or, at the other extreme, remain at a superficial level which does not consider the hazards sufficiently. The HAZOP study alone does not improve the safety of an installation. From experience, one of the most difficult aspects appears to be an adequate description of the intended operation, including all of the relevant parameters. If parameters which are safety critical or safety relevant are not included in the study then it is not possible to analyse the consequences of deviations of these parameters from the intended operation.

The HAZOP study does not consider the expected frequencies of occurrence of the deviations. To assess the risks fully, additional methods are needed.

4. What If?

The "What If?" analysis is a scenario based approach to hazard identification and consequence assessment.

For example:

- What if the level rises above x?
- What if the temperature is greater than t °C?
- What if the <parameter> is <comparison><intended state>?

It is similar in some ways to the HAZOP study, however is highly dependent on the knowledge and experience of those who develop the scenarios to be considered by the question "What If?" Answers can only be generated for the questions which are posed. There is no internal control within the method which identifies the completeness of the study.

The system is suitable for simple, well understood systems or as a "brain storming" technique. However the system is weak in generating new knowledge out of existing information.

5. Risk Matrix

By using a "Risk Matrix" it is possible to compare various hazards in relation to their consequences and their expected frequencies. The analysis is carried out in a team. The most important step is the identification of the hazards. This can be carried out, for example, with a systematic method such as a HAZOP study.

The consequences are classified in categories, for example:

1. catastrophic;
2. critical;
3. slight; and
4. negligible.

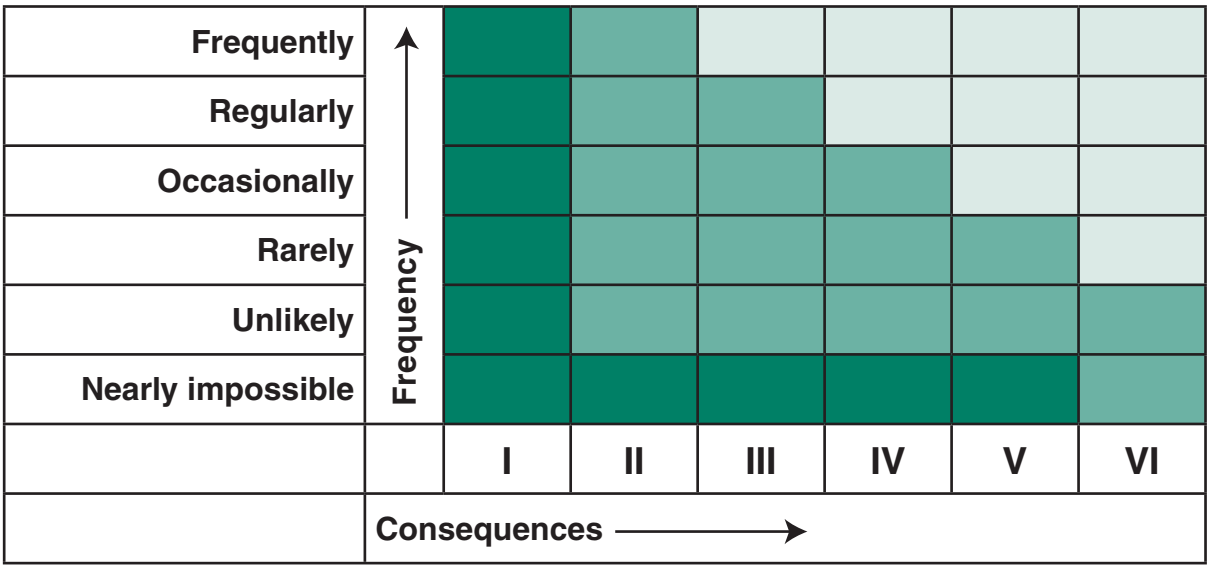
Similarly the frequencies can be classified in relative classes either based on numerical, probabilistic data or experience for example:

A. frequently;
B. regularly;
C. occasionally;
D. rarely;
E. unlikely; and
F. nearly impossible.

Within the risk matrix the hazards are placed according to their frequencies and consequences. By setting a target risk level as a diagonal within the matrix, it is possible to determine which hazards must either be eliminated completely or their consequences or frequencies reduced.

An advantage of this approach is that it is not dependent on frequency numbers for the assessment of risks. However it does require a certain degree of skill and experience to ensure a consistent assessment of risks. The classification of the hazards should be carried out in a team to ensure the best use of the available experience. This method also allows the team to see where it is most important and most effective to apply risk reduction measures to reduce the overall risk from the facility.

Example of a Risk Matrix



Consequences:

I: negligible
II: minimal
III: medium
IV: large
V: very large
VI: catastrophic

Risk Levels:

Broadly acceptable

Tolerable, however risks should be reduced as far as possible

Intolerable

SG

SG-3: Guidance on Emergency Planning

There are a number of international publications that provide guidance on emergency planning related to chemical accidents.

These include documents from:

- UNEP including the *APELL Handbook* (1988), *Good practice in emergency preparedness and response* (UNEP and ICMM 2006), and other APELL-related materials.
- The Joint UNEP/OCHA Environment Unit including, for example, *Guidelines for the Development of a National Environmental Contingency Plan*.
- ILO including the *Code of Practice on the Prevention of Major Industrial Accidents* (1991).
- WHO including the *Manual for the Public Health Management of Chemical Incidents* (2009).
- OECD including the *Guiding Principles for Chemical Accident Prevention, Preparedness and Response* (2nd ed., 2003).

Text Box 10 (Issues to be Addressed in Emergency Preparedness Planning) on page 76 contains an overview of the issues to be addressed in emergency planning, based on guidance from the APELL Handbook.

The following are some additional general principles concerning preparedness planning (from the OECD *Guiding Principles for Chemical Accident Prevention, Preparedness and Response* (2nd ed., 2003). In the following, the term "public authorities" is used to encompass government bodies at different levels:

- Public authorities should ensure the development, implementation, testing and updating of off-site and on-site emergency plans in coordination with the management of hazardous installations and, as appropriate, with the participation of employees and representatives of relevant communities.
- The off-site emergency plan and all relevant on-site emergency plans should be consistent and integrated and there should be close cooperation between those responsible for off-site and on-site emergency planning.
- Public authorities should establish guidelines and standards for developing off-site and on-site emergency plans.
- The objective of emergency planning activities/programmes should be to put into place the arrangements needed to localise any accidents that may occur and, if possible, contain them and thereby minimise their harmful effects on health, the environment, and property.
- A prerequisite for effective emergency planning is the identification of the hazardous installations located within the area to be covered by the emergency plan.
- Other risks, such as the risks of transport accidents involving hazardous substances and natural disasters, should be taken into consideration in emergency planning for hazardous installations.
- As part of the emergency planning process, there should be an elaboration of possible scenarios, and an identification of the potential risks and the geographical zones where effects are likely to occur in the event of an accident.
- The emergency planning process should include the assessment of potential environmental consequences of accidents, as well as potential health consequences. This assessment should take into account the possibility that adverse effects could result from: direct contact with toxic or irritating substances; thermal radiation or overpressure; indirect exposure (for example, through ingestion of contaminated food or water); or indirect injuries (for example, from collapsing structures, projectiles, or fire).
- Emergency planning should take into account the special situation of local institutions that may have particularly sensitive populations and critical infrastructures, such as schools, hospitals, homes for the elderly, and prisons.
- Emergency planning should take into account potential complicating factors that could be associated with accidents at hazardous installations, as well as factors that may make response more difficult. These include, for example, extreme weather conditions, natural disasters, loss of power or water supplies, problems with communication and transportation systems, synergistic effects of accidents with multiple substances, "domino effects," and sabotage.

- Emergency plans should provide the necessary guidance to allow for flexible response to a range of possible situations (from small accidents to worst-case scenarios). An emergency plan cannot provide prescriptive instructions for response, since each accident by its nature will be different and will often involve a combination of aspects that may not have been considered during the planning process.
- During the emergency planning process, there should be a realistic assessment of the existing skills, equipment, and other resources that are available for a response effort, and an assessment of the skills, equipment, and other resources required based on the range of possible accident scenarios, including worst-case scenarios. These assessments will provide insight into what additional skills, equipment, and resources are needed.
- Emergency plans (on-site and off-site) should identify the roles and responsibilities of all the parties concerned and should indicate the chain of command, the lines of communication, the coordination among parties, and the means for obtaining necessary information, resources, and equipment.
- As part of the emergency planning process, it should be ensured that adequate medical facilities are available, including transportation facilities.
- All parties who will be involved in an emergency response effort (*e.g.*, fire, police) should be involved in the emergency planning process. There should be opportunities for representatives of the public to provide input into the emergency planning process. Representatives of the media should also be involved during development of emergency plans.
- Health/medical personnel – who may be involved in an emergency response involving hazardous substances – should be acquainted with the hazardous substances that are produced, used, transported, or otherwise handled in significant quantities in their community. Health/medical personnel should also be aware of relevant aspects of local emergency plans, and of their roles within these plans.
- All personnel involved in the emergency response process (including, for example, first responders such as police, fire, and ambulance personnel) should be trained and educated on a continuing basis to ensure that a state of readiness for varying contingencies is maintained.
- On-site and off-site emergency plans should be tested and reviewed regularly, updated as appropriate, and maintained up-to-date taking into account, for example, changes in the nature of the risks, new residential and commercial developments in the area, improvements in response technology and capabilities, lessons learned from exercises/tests and from application of plans during accidents and near-misses, and changes in personnel.
- Testing of emergency plans at appropriate intervals is critical for ensuring that they are adequate, complete and realistic, and that the various plans applicable in an area (on- and off-site) are compatible. Testing also provides a means to identify gaps or needs with respect to the availability of appropriate personnel (including training needs), equipment, supplies, and information. In addition, testing increases the confidence of response personnel in being able to deal with real emergencies.
- The individuals who will be involved in the event of an accident should be involved in the tests/exercises.
- Maximum benefit is gained from conducting exercises/tests in a “no blame environment” (*i.e.*, no blame is assigned for errors or problems identified). In such a case, all participants can feel free to be open and honest in their evaluations without fear of repercussions.
- All responsible parties should ensure that human resources, equipment (including communication equipment and personal protective equipment), financial, and other resources necessary to carry out emergency plans are readily available for immediate activation in the event, or imminent threat, of an accident.
- Public authorities in neighbouring communities (within a country or across borders) should pool resources (including equipment, expertise, health-related resources and information) in order to make the best use of response capabilities.
- Mechanisms should be established for assistance, from neighbouring or other relevant communities within the country or across borders in the event an accident exceeds local response capability.
- Public authorities should ensure that emergency responders have access to sources of information (such as designated information centres) capable of providing the information needed in an emergency for the diagnosis, treatment, and rehabilitation of persons injured by hazardous substances.
- Systems and procedures should be in place for the rapid detection of an accident or imminent threat of an accident, and for the immediate notification of emergency response personnel.

- The emergency planning process should include an elaboration of the methods to be used to inform the public of what to do in the event of an emergency, and how the public will be informed when an accident occurs. The potentially affected public should be notified of the systems which will be used to warn them in the event of an emergency, and the systems should be tested in advance.
- When alerted to an accident involving hazardous substances, response authorities should activate their emergency plans, including mechanisms for ensuring that the public is notified and informed about what actions to take to minimise adverse consequences.
- Among the reasons why emergency plans, although theoretically sound, fail in their application include: not taking account of the lack of information available at the time of the accident; insufficient training; insufficient coordination; breakdowns in communication; failure to recognise limitations of individuals in stressful situations; and a plan that is too complex or places too many demands on certain individuals.

SG-4: Guidance on Health Aspects of Chemical Accidents

The following are some additional general principles concerning health aspects of chemical accidents (from the OECD *Guiding Principles for Chemical Accident Prevention, Preparedness and Response* (2nd ed., 2003).[35]

Further guidance is available in the WHO *Manual for the Public Health Management of Chemical Incidents* (2009).

In the following, the term "public authorities" is used to encompass government bodies at different levels.

Emergency Planning – General

- Public authorities should identify all parties who are expected to participate in an emergency response as part of the development of an off-site emergency plan. In addition, the roles, resources, and capabilities of these participants should be realistically established and their commitment obtained. These participants should include, among others, medical (including hospitals), welfare services, and public health and environmental agencies.
- Emergency plans should include detailed information for first responders on, *inter alia*, how the various response groups (including health/medical personnel) should work together, and how to undertake the identification, triage, and initial treatment of victims.
- Emergency planning should take into account the range of possible health effects (acute effects, long-term effects, and psychological effects) that could result from chemical accidents, and the response actions that should be taken to address these affects on response personnel, employees, and the community.
  - It should be taken into account that health effects on exposed populations can be short-term and/or long-term. Adverse effects may appear immediately or some time after the accident. Such effects might be direct or indirect. Psychological effects, not necessarily related to exposure to the hazardous substances, could appear during or after the accident.
  - Emergency planning should also take into account mechanisms for reducing stress on, and providing counselling services for, those with responsibilities for crisis management and communication.
- The emergency planning process should take into account the need to protect health care workers from exposure to hazardous substances.
  - Such exposure could result from handling victims who have not been adequately decontaminated or from unexpected exposure at the site due to, for example, changes in wind direction.
  - Health care providers normally should not enter contaminated areas, unless there are exceptional circumstances (*e.g.*, for triage or life-saving procedures). In such cases, they should be fully protected and accompanied by rescue personnel, and should not be allowed to exceed established exposure limits.
- Hospitals and other treatment facilities, which may be called on during response to an accident involving hazardous substances, should develop emergency plans (coordinated with the local off-site plan).
  - These plans should describe systems/procedures for receiving and handling large numbers of patients at one time.
  - These systems/procedures should address, for example: triage; arrangements for patient identification and documentation; and possible decontamination.
  - Public authorities should ensure that these plans are in place, and should assist in their development.
- The organisation and planning of health-related response to accidents should involve veterinarians, biologists, and others familiar with the care of livestock, pets and wildlife, both in order to protect the animals and to provide support to their owners/caretakers.

Training

- Emergency response training and education should allow response personnel to take appropriate actions to minimise the adverse effects to health and the environment from accidents involving hazardous substances. It should also allow them to improve their ability to gather information concerning possible adverse effects on health or the environment.

---

[35]This guidance was derived from: IPCS, OECD, UNEP, and WHO (Joint Publication), *Health Aspects of Chemical Accidents, Guidance on Chemical Accident Awareness, Preparedness and Response for Health Professionals and Emergency Responders* (1994)

- Emergency response training and education should, as a minimum, allow first responders to become familiar with:
  - the local emergency plan(s);
  - the hazardous installations in the community, including the results of the risk assessment of these installations;
  - the need for protective measures when responding to accidents involving hazardous substances, including the use of protective clothing and equipment;
  - important properties of different hazardous substances in their communities, and the means for responding to accidents involving such substances;
  - contamination hazards and procedures for decontamination;
  - specific first aid measures; and
  - possible adverse psychological effects on victims, emergency responders and the public.
- Health/medical personnel should contribute, where appropriate, to training those outside the health sector who are likely to be involved in emergency response activities.
- There should be joint training and exercises among stakeholders who may be involved in the emergency response (including, for example, response personnel and health/medical personnel).

- Public health and education authorities should ensure the basic training of all relevant health/medical and paramedical professionals in the principles of medical toxicology and emergency medicine. This training and education should be continuous, with regular updating, taking account of changes in emergency plans and arrangements, risks in the community, available resources, and other relevant factors.

Access to Information and Expertise

- Public authorities should ensure that emergency responders have access to sources of information (such as designated information centres) capable of providing the information needed in an emergency for the diagnosis, treatment and rehabilitation of persons injured by hazardous substances.
  - These centres, or other sources, should have information on:
    - the hazardous substances involved in the accident;
    - first aid and medical treatment;
    - medical facilities and means of transporting victims;
    - how and when to contact essential services;
    - the command structure for the response; and
    - lists of available experts.
  - Public authorities should determine the best approach for ensuring access to essential information. Information sources could include specialised centres established to organise the collection, collation and dissemination of emergency planning and response information concerning human exposure to hazardous substances, such as poison information centres (PICs). They could also include academic institutions, industrial organisations, or other sources. Lists of information sources in various fields should be maintained.
  - Information should be available from the designated information sources/centres on a 24-hour basis every day of the year.
  - Representatives of information sources/centres should be available to participate in, or contribute to, the emergency planning process, as appropriate.
  - Where there are more than one designated information source/centre in a country, they should be suitably linked.
  - Networking among information sources should be promoted.
  - Information sources/centres in different countries should share information and experience.
  - An up-to-date list of national and international experts in various fields related to emergency preparedness and response should be maintained. In addition, there should be an international listing of groups of experts who can make themselves available to countries requiring assistance in the event of an emergency.

Access to Medical Resources

- As part of the emergency planning process, there should be an assessment of the types of emergency medical resources needed to respond to different types of emergencies and to the range of possible casualties. It should be assured that the adequate medical facilities are available, including transportation facilities as well as decontamination equipment for on-site and hospital use and, as appropriate, protective equipment for medical emergency response personnel.
  - Public authorities, in cooperation with hospitals/treatment facilities, should establish back-up procedures and systems for moving and treating large number of victims if local hospitals and treatment facilities are inadequate (*e.g.*, insufficient capacity or lack of specialised facilities).
  - In order to accommodate emergency needs, provision should be made for the rapid transformation of facilities normally used for other purposes. For example, when access to hospitals is limited, alternative premises such as schools, sports facilities, and tents should be identified as places where temporary medical care could be provided to accident victims.
  - Emergency plans should indicate the protective measures that should be taken in the event a hospital or other treatment facility is contaminated, or otherwise is threatened as a result of an accident (*e.g.*, loss of electricity, structural damage, or when the hospital is downwind from a release of hazardous substances).
    - Hospitals/treatment facilities should make provisions for evacuating patients or for decontamination in the event the facilities become contaminated.
    - Hospitals should also be aware that they may need to take special precautions if they have hazardous substances on site, or if they receive contaminated patients.
- As part of the emergency planning process, the availability of oxygen should be ensured, as well as up-to-date antidotes and other pharmaceutical substances necessary for the treatment of persons injured by hazardous substances.
  - Antidotes and other pharmaceutical substances should be maintained so that they remain effective (*e.g.*, they should be properly stored and should not be kept past their recommended shelf life).
  - Public authorities and management of hazardous installations should promote the development of effective antidotes for those hazardous substances that have no (or insufficient) antidotes.
- Both industry and public authorities should establish mechanisms to facilitate pooling and/or sharing medical resources in the event of an accident (within a community, between neighbouring communities, and between countries). Such medical resources could include facilities, equipment, supplies, information, and personnel.

SG-5: Guidance on Pipelines

The following are some additional general principles concerning the safety of pipelines (from the OECD *Guiding Principles for Chemical Accident Prevention, Preparedness and Response* (2nd ed., 2003).

Further guidance can be found in the UNECE Document entitled: *Prevention of Accidental Water Pollution – Safety Guidelines and Good Practices for Pipelines*, Submitted by the Joint Expert Group on Water and Industrial Accidents (2006).

While the *Guidance* contained in this Flexible Framework generally applies to pipelines, this text addresses special concerns with respect to pipelines transporting hazardous substances. For purposes of this document, pipelines are defined to include ancillary facilities, such as pumping and compression stations.

Regulatory approaches to pipelines differ significantly among countries although there are common elements in most approaches (including a general obligation to operate safely). Despite the differences in regulatory approaches, industry appears to have similar safety practices in different countries in order to maintain the integrity of pipeline networks.

- Pipelines for transporting hazardous substances should be designed, constructed, operated, maintained and monitored so as to reduce the frequency of accidents and to mitigate the consequences of accidents that do occur.
  - Pipelines should be designed, constructed and operated consistent with recognised national and international codes, standards, and guidance, as well as company specifications.
  - Consideration should be given to various aspects which could have an impact on the safety of a pipeline including, *e.g.*, design and stress factors, material quality, wall thickness, depth of burial, external impact protection, markings, route selection, and monitoring.
  - Comparative risk assessments should be undertaken in order to choose from among different materials and other options.
  - Pipelines should be constructed with the most suitable materials available to ensure their integrity initially and throughout their lifecycle. Appropriate safety technology should be used such as automatic shutdown systems (in the event of a leak or accident) or safety release systems.
  - Adequate safety signs should be installed along the pipeline route.
- Land-use planning considerations and risk assessments should be taken into account both in the routing of new pipelines (*e.g.*, to limit proximity to populated areas to the extent possible), and in decisions concerning proposals for new developments/building in the vicinity of existing pipelines.
  - Environmental impact assessment for geological hazards should also be taken into account in order to avoid (to the extent possible) hazardous geologic environments, such as areas susceptible to sinkholes and seismic activity.
  - Routing of pipelines should be chosen to minimise adverse impacts in the event of an accident, and to facilitate access for maintenance and for emergency response personnel.
- Industry should develop safety management systems to meet safety objectives during design, construction, operation, maintenance and decommissioning of pipelines.
  - Elements of safety management systems for pipelines include: clear objectives and policies; a suitable organisation with clear defi nitions of asset ownership and related responsibilities; competent staff and effective education and training; adequate standards and procedures; performance monitoring and suitable audit/review procedures to identify shortcomings and make corrections; emergency response procedures which are regularly tested and reviewed; and accident investigations.
  - Industry should continue to share its experience with respect to the use of safety management systems for pipelines, and improve the efficiency of individual elements/techniques of these systems, with the aim of further reducing pipeline accidents.
- The integrity of pipelines should be maintained through adequate maintenance, inspection and monitoring, and sound management.
  - Means for inspection and monitoring include the use of “intelligent pigs” (devises that are inserted into and travel throughout the length of a pipeline driven by product flow), patrolling, and aerial surveillance.

- In addition to regular maintenance, the objective of continued improvement in safety performance can be achieved by inspection and monitoring, a wider exchange of information among operators, taking into account lessons learned from reported incidents, and utilisation of new technologies and other developments.
- As pipelines age, additional monitoring may be necessary to continue to ensure their integrity. Consideration should be given to reviewing and revalidating pipelines and their operating conditions once they reach the end of their originally-intended design life.
- Policies should be in place for replacing pipelines, or parts of pipelines, that may not meet safety standards or have reached the limits of their design life.

▪ While the general principles applicable to emergency planning for hazardous installations also apply to pipelines, it may be necessary to make further efforts, taking into account the specific situation of pipelines including, for example, the hazards associated with the substance they transport.

- Emergency planning for pipelines may be complicated because of some of their characteristics including, for example: the fact that pipelines are normally unmanned; the length and location of pipelines; the need to be able to shut off or depressurise the flow of materials; and the need to ensure access by emergency response personnel. In addition, account should be taken of nearby developments. For example, where pipelines cross or parallel rail lines, it is important to interface with plans of the rail industry.
- Emergency planning should take into account a risk assessment of the pipeline system.
- In light of these complexities, it is important to get input from emergency response personnel when preparing, reviewing and revising emergency plans related to pipelines.

▪ Industry responsible for pipelines should review and, as necessary, develop and implement systems to reduce third-party interference, as this is a major cause of accidents.

- This should be done in cooperation with public authorities in all regions/countries.
- Systems for reducing third-party interference involve ensuring that proper information is circulated among interested parties concerning the locations of pipelines in a given area. In addition, it is important to facilitate communication between the pipeline operator and third parties, such as through “one call” systems that provide information about pipelines at one well publicised source.

▪ In order to facilitate learning from experience, industry responsible for pipelines (as well as public authorities and other stakeholders) should improve sharing of information on improving safety of pipelines and on accidents/near-miss case histories.

- This should include information concerning pipelines that reach the end of their intended useful or design life. Options for dealing with pipelines that are no longer in use include removal, outright abandonment, or abandonment with additional actions. Care should be taken to properly assess the associated risks of each option, on a case-by-case basis, recognising that the best solution in a given situation may be a combination of methods.
- Information should also be pooled and shared on the extent of pipeline systems, on the amount of materials they convey, and on statistical analyses of the use of pipelines to transport hazardous substances.
- Information should be collected and made available concerning the relationship between failure and the characteristics of the pipeline, in order to better understand the nature and causes of accidents (*e.g.*, relating to age, size, location, and construction of the pipeline).

SG-6: Guidance on Accident Investigations

The following are some additional general principles concerning the accident investigations (from the OECD *Guiding Principles for Chemical Accident Prevention, Preparedness and Response* (2nd ed., 2003).

- An investigation should be a fact-finding activity to learn from experience, not an exercise designed to allocate blame or liability. Those involved should be reassured of this. There should be full cooperation between the operational staff at the installation and those involved in the investigation.
- The emphasis in conducting investigations should be on identifying the underlying causes (sometimes called the "root" causes) in a chain of events leading to an accident, the lessons to be learned, and ways to prevent similar accidents in the future. The investigation should not be limited to determining the immediate or apparent cause(s).
- It should be recognised that accidents are generally the final stage of a long sequence of events in which there is a complex interplay between technical defects, human error, and insufficient organisation/ management.
- Where "human error" is involved, the cause should not simply be so recorded. Rather, investigators should determine exactly what elements contributed to any human error. Such elements could include, *e.g.*, boredom, stress, overwork, or insufficient training. Other root causes could be: the system was not sufficiently error tolerant; the operating procedures were not made available in written form or were not kept up-to-date; the procedures were not realistic, created difficult circumstances, or called for illogical actions by the operator; there was poor ergonomic or system/technology design; the process design did not provide the operator with enough data or provided too much data to expect an appropriate response; staffing was insufficient; there was undue pressure on the operator or manager to sacrifice safety to higher productivity; or a reorganisation or a change in staff was not properly managed.
- Human errors are not limited to operator errors but may occur at different points in the hierarchy of the enterprise including, for example, at the level of those responsible for maintenance, management of change or permit to work systems, or at the level of supervisors and management. Examples of human failures, in addition to operator errors, can involve: problems with transmission of knowledge, especially when experienced specialists retire; the complexity of the system, including process design and engineering; the ageing of plants and related repairs, without adequate maintenance and inspection; and the need to cope with changes in organisation or technology, including automation.
- The procedure for root cause investigations of accidents should be systematic, thorough, and fair. The procedures should consist of four main phases:
  - The first phase is before there is access to the accident site, when a number of steps can be taken to further the investigation including: organising the investigation team; interviewing eyewitnesses; organising an information and tracking system; organising lists of factors which might have influenced the event; developing the preliminary list of scenarios; coordinating with the emergency response team to ensure preservation of evidence; undertaking investigations outside the restricted areas; preparing for large volumes of information; and taking aerial photographs.
  - The second phase consists of the initial site visit, when it is important to document the condition of the site, revise investigation plans, and identify time-sensitive evidence.
  - The third phase is during the ongoing investigation, when the focus will be on recovery of evidence, reconstruction, analysis, testing, and simulation of scenarios, and systematically affirming or denying scenarios.
  - The fourth phase involves preparation of the investigation report and recommendations, which should be completed in a timely manner to avoid delays in the application of improvements.
- In designing and implementing root cause investigations, efforts should be made to address possible constraints, or challenges, to conducting effective investigations, such as:
  - the destruction or deterioration of evidence by possible memory distortion of witnesses over time, and the fact that the investigation occurs under stressful circumstances and may last for a number of months;
  - limiting the possible scenarios examined, and thereby biasing the collection of evidence to try to match the chosen scenarios;
  - laws designed to promote public access to information, as well as laws to protect confidential business information, that can present hurdles to the collection and sharing of relevant evidence;
  - constraints due to limited financial or human resources available, relative to the complexity of the investigation;

- insufficient trust among parties involved;
- liability issues; and
- actions taken to make the site safe.

- The use of a computer database for storing the key elements of incidents can facilitate their analysis. Particular trends can be highlighted and historical data can be used proactively in accident prevention, for example by orienting safety training towards the avoidance of the type of incidents that have occurred.

ANNEXES

Annex I: Definition of Terms

These definitions are provided for purpose of this Guidance only. They should not be considered agreed definitions. Unless otherwise noted, they have been derived from the OECD Guiding Principles for Chemical Accident Prevention, Preparedness and Response *(2nd ed., 2003).*

Other international documents, and different countries, may define these in somewhat different ways. Each country should decide how to define terms in their laws, policies, and programmes in light of their legal and cultural context.

Accident or chemical accident:
Any unplanned event (such as a spill, release, fire, or explosion) involving hazardous substances that causes, or is liable to cause, harm to health, the environment, or property. This excludes any long-term events (such as chronic pollution).

> **Examples of Types of Chemical Accidents:**
> **Explosion:** Violent release of energy resulting from a rapid chemical reaction.
> **Fire:** Combustion of a material with the production of heat, light, smoke, etc.
> **Leak:** Gaseous, liquid, or solid release arising from a fault in a container or pipe.
> **Spill:** Unintentional gaseous, liquid, or solid release from an intact container or pipe.

Chemical accidents programme:
Encompasses the collection of laws, regulations, policies, guidance, and other instruments developed by a country to address the various aspects of chemical accident prevention, preparedness, response, and recovery. These may be administered by different authorities at national, regional, and/or local levels. (Note: this definition was developed for this *Guidance.*)

Community(ies):
Individuals living/working near hazardous installations who may be affected in the event of a chemical accident.

Consequence:
Result of a specific event.

Emergency preparedness plan (or) emergency plan:
A formal written plan which, on the basis of identified potential accidents together with their consequences, describes how such accidents and their consequences should be handled, either on-site or off-site.

Employee:
Any individual(s) working at, or on behalf of, a hazardous installation. This includes both owners/operators and workers, as well as (sub)contractors.[36]

Enterprise:
A company or corporation (including transnational corporations) that has operations involving production, processing, handling, storage, use, and/or disposal of hazardous substances.

Hazard:
An inherent property of a substance, agent, source of energy, or situation having the potential of causing undesirable consequences.

[36]This *Guidance* uses the term "workers" where the OECD *Guiding Principles* uses the term "labour."

Hazard analysis:
Identification of individual hazards of a system, determination of the mechanisms by which they could give rise to undesired events, and evaluation of the consequences of these events on health, (including public health) environment, and property.

Hazardous installation:
A fixed industrial plant/site at which hazardous substances are produced, processed, handled, stored, used, or disposed of in such a form and quantity that there is a risk of an accident involving hazardous substance(s) that could cause serious harm to human health or damage to the environment, including property.

Hazardous substance:
An element, compound, mixture, or preparation which, by virtue of its chemical, physical, or (eco)toxicological properties, constitutes a hazard. Hazardous substances also include substances not normally considered hazardous but which, under specific circumstances (*e.g.*, fire, runaway reactions), react with other substances or operating conditions (temperature, pressure) to generate hazardous substances.

Land-use planning:
Consists of various procedures to achieve both general zoning/physical planning, as well as case-by-case decision-making concerning the siting of an installation or of other developments.

Near-miss:
Any unplanned event which, but for the mitigation effects of safety systems or procedures, could have caused harm to health, the environment, or property, or could have involved a loss of containment possibly giving rise to adverse effects involving hazardous substances.

Owner/Operator:
Any individual or legal entity (public or private) having decision-making responsibility for an installation (including management).[37]

Pipeline:
A tube, usually cylindrical, through which a hazardous substance flows from one point to another. For purposes of this publication, pipelines include any ancillary facilities such as pumping and compression stations.

Port area:
The land and sea area established by legislation. (Note: some port areas may overlap. Legal requirements should take account of this possibility.)

Presence of hazardous substance:
The actual or anticipated presence of a substance in an installation, or the presence of those which it is believed may be generated during loss of control of an industrial chemical process, in quantities equal to or in excess of the established thresholds (this is based on the Seveso II Directive).

Probability:
The likelihood that a considered occurrence will take place.

Producer(s) (chemical):
Enterprises that manufacture or formulate chemical products (including basic and specialty chemicals, consumer care products, agrochemicals, petrochemicals, and pharmaceuticals).

Public authorities:
Government bodies at national, regional, local, and international level.

Reasonably practicable:
All which is possible, subject to the qualification that the costs of the measures involved are not grossly disproportionate to the value of the benefits obtained from these measures.

Risk:
The combination of consequence and the probability of its occurrence.

[37]This is the OECD definition for management

Risk assessment:
The informed value judgment of the significance of a risk, identified by a risk analysis, taking into account any relevant criteria.

Risk communication:
The sharing of information, or dialogue, among stakeholders about issues related to chemical accident prevention, preparedness, and response including, *e.g.*, health and environmental risks and their significance; policies and strategies aimed at managing the risks and preventing accidents; and actions to be taken to mitigate the effects of an accident. For purposes of this document, risk communication includes dialogue and sharing of information among the public, public authorities, industry, workers, and other stakeholders.

Risk management:
Actions taken to achieve or improve the safety of an installation and its operation.

Root cause(s):
The prime reason(s) that lead(s) to an unsafe act or condition and result(s) in an accident or near miss. In other words, a root cause is a cause that, if eliminated, would prevent the scenario from progressing to an accident. Root causes could include, for example, deficiencies in management systems that lead to faulty design or maintenance, or that lead to inadequate staffing.

Safety management system:
The part of an enterprise's general management system that includes the organisational structure, responsibilities, practices, procedures, processes, and resources for determining and implementing a chemical accident prevention policy. The safety management system normally addresses a number of issues including, but not limited to: organisation and personnel; identification and evaluation of hazards and risks; operational control; management of change; planning for emergencies; monitoring performance; and audit and review.

Safety report:
The written presentation of technical, management, and operational information concerning the hazards of a hazardous installation and their control in support of a justification for the safety of the installation.

Stakeholder:
Any individual, group, or organisation that is involved, interested in, or potentially affected by chemical accident prevention, preparedness, and response.

Storage facilities:
Warehouses, tank farms, and other facilities where hazardous substances are held.

Transboundary accident:
An accident involving hazardous substances that occurs in one jurisdiction and causes adverse health or environmental consequences (effects), or has the potential to cause such consequences, in another jurisdiction (within a country or across national boundaries).

Transport interface:
Fixed (identified) areas where hazardous substances (dangerous goods) are transferred from one transport mode to another (*e.g.*, road to rail, or ship to pipeline); transferred within one transport mode from one piece of equipment to another (*e.g.*, from one truck to another); transferred from a transport mode to a fixed installation or from the installation to a transport mode; or stored temporarily during transfer between transport modes or equipment. Thus, transport interfaces involve, for example, loading and unloading operations, transfer facilities, temporary holding or keeping of hazardous substances during cargo transfer (*e.g.*, warehousing), and handling of damaged vehicles or spilled goods. Examples include: railway marshalling yards, port areas, receiving/loading docks at hazardous installations, terminals for roads and for intermodal transport between road and rail, airports, and transfer facilities at fixed installations.

Workers:
Any individual(s) working at, or on behalf of, a hazardous installation who is not part of management. This includes (sub)contractors.

Annex II: Acronyms

This Annex has two parts:

- Part A contains general acronyms related to chemical accident prevention and preparedness.
- Part B contains the acronyms for agencies and international organisations referred to in this *Guidance*.

The Bibliography also contains a list of organisations and their websites.

a. General Acronyms

APELL:
Awareness and Preparedness for Emergencies at the Local Level (UNEP)
(www.unep.fr/apell)

BLEVE:
Boiling liquid expanding vapour explosion

CNG:
Compressed natural gas

GHS:
The Globally Harmonized System of Classification and Labelling of Chemicals

HAZOP:
Hazard and operability studies

LNG:
Liquefied natural gas

LPG:
Liquefied petroleum gas

RMP:
Risk Management Plan (US EPA)
(www.epa.gov/emergencies)

SAICM:
Strategic Approach to International Chemicals Management
(www.saicm.org)

SMEs:
Small and medium-sized enterprises

SMS:
Safety management systems

SPI:
Safety performance indicators

TDG:
Transport of Dangerous Goods (UNECE)
(http://www.unece.org/trans/danger/danger.htm)

UVCE:
Unconfined vapour cloud explosion

VCE:
Vapour cloud explosion

b. Acronyms of Organisations Referenced in this *Guidance*

ADPC:
Asian Disaster Preparedness Centre
(http://www.adpc.net/v2007/)

CCPS:
Center for Chemical Process Safety
(http://www.aiche.org)

CETEM/CYTED:
Centre for Mineral Technology/Latin American Science and Technology Development Programme
(http://cyted.org/) (www.cetem.gov.br) (*Centro de Tecnologia Mineral/Programa Iberoamericano de Ciencia y Tecnologia para el Desarrollo*)

EC:
European Commission
(http://ec.europa.eu) (http://ec.europa.eu/environment/seveso) See also MAHB

EPA:
Environmental Protection Agency (US)
(www.epa.gov/emergencies)

EPSC:
European Process Safety Centre
(www.epsc.org)

EU:
European Union
(http://europa.eu)

IMOC:
Inter-Organization Programme for the Sound Management of Chemicals
(www.who.int/iomc)

IATA:
International Air Transport Association
(http://www.iata.org)

ICAO:
International Civil Aviation Organization
(http://www.icao.int/)

ICCA:
International Council of Chemical Associations
(http://www.icca-chem.org/)

ICMM:
The International Council on Mining and Metals
(www.icmm.com)

IchemE:
Institution of Chemical Engineers
(http://cms.icheme.org)

IFCS:
Intergovernmental Forum on Chemical Safety
(http://www.who.int/ifcs/en/)

IPCS:
International Programme on Chemical Safety
(www.who.int/pcs)

ILO:
International Labour Organization
(www.ilo.org)

ISO:
International Organization for Standardization
(www.iso.org)

JEU:
Joint UNEP/OCHA Environment Unit
(http://ochaonline.un.org/ochaunep/)

JRC:
Joint Research Centre (EC)
(www.jrc.ec.europa.eu)

MAHB:
Major Accident Hazards Bureau
(http://mahb.jrc.ec.europa.eu/)

MSB:
Swedish Civil Contingencies Agency
(http://www.msb.se/en/) (*Myndigheten för samhällsskydd och beredskap*)

OCHA:
United Nations Office for the Coordination of Humanitarian Affairs
(http://ochaonline.un.org)

OECD:
Organisation for Economic Co-operation and Development
(www.oecd.org/ehs)

UN:
United Nations
(www.un.org)

UNECE:
UN Economic Commission for Europe
(www.unece.org) (www.unece.org/env/teia)

UNEP:
United Nations Environment Programme
(www.unep.org)

UNEP DTIE:
UNEP Division of Technology, Industry and Economics
(www.unep.fr)

UNIDO:
United Nations Industrial Development Organization
(www.unido.org)

UNITAR:
United Nations Institute for Training and Research
(http://www.unitar.org/)

WHO:
World Health Organization
(www.who.int)

Annex III: Lists of Chemicals of Concern

This Annex contains copies of the lists of substances subject to chemical accidents programmes from:

a. Seveso II Directive (European Union) which is also used as a basis for UNECE Convention;

b. US Risk Management Program;

c. Swiss Ordinance on the Protection against Major Accidents; and

d. Korean Industrial Safety and Health Law.[38]

a. EU: LIST OF CHEMICALS and THRESHOLDS Seveso II Directive

ANNEX I: APPLICATION OF THE DIRECTIVE

Introduction

1. This Annex applies to the presence of dangerous substances at any establishment within the meaning of Article 3 of this Directive and determines the application of the relevant Articles thereof.
2. Mixtures and preparations shall be treated in the same way as pure substances provided they remain within concentration limits set according to their properties under the relevant Directives given in Part 2, Note 1, or their latest adaptation to technical progress, unless a percentage composition or other description is specifically given.
3. The qualifying quantities set out below relate to each establishment.
4. The quantities to be considered for the application of the relevant Articles are the maximum quantities which are present or are likely to be present at any one time. Dangerous substances present at an establishment only in quantities equal to or less than 2% of the relevant qualifying quantity shall be ignored for the purposes of calculating the total quantity present if their location within an establishment is such that it cannot act as an initiator of a major accident elsewhere on the site.
5. The rules given in Part 2, Note 4 governing the addition of dangerous substances, or categories of dangerous substances, shall apply where appropriate.
6. For the purposes of this Directive, a gas is any substance that has an absolute vapour pressure equal to or greater than 101,3 kPa at a temperature of 20 °C.
7. For the purposes of this Directive, a liquid is any substance that is not defined as a gas and that is not in the solid state at a temperature of 20 °C and at a standard pressure of 101,3 kPa.

Part 1: Named substances

Where a substance or group of substances listed in Part 1 also falls within a category of Part 2, the qualifying quantities set out in Part 1 must be used.

Column 1	Column 2	Column 3
Dangerous substances	Qualifying quantity (tonnes) for the application of:	
	Articles 6 and 7	Article 9
Ammonium nitrate (see Note 1)	5,000	10,000
Ammonium nitrate (see Note 2)	1,250	5,000
Ammonium nitrate (see Note 3)	350	2,500
Ammonium nitrate (see Note 4)	10	50
Potassium nitrate (see Note 5)	5,000	10,000
Potassium nitrate (see Note 6)	1,250	5,000
Bromine	20	100
Chlorine	10	25
Nickel compounds in inhalable powder form (nickel monoxide, nickel dioxide, nickel sulphide, trinickel disulphide, dinickel trioxide)	-	1

[38]Because the Korean law is not available in English, only a table showing chemicals of concern is included while associated language within the text of the law has not been translated.

Column 1	Column 2	Column 3
Dangerous substances	Qualifying quantity (tonnes) for the application of:	
	Articles 6 and 7	Article 9
Ethyleneimine	10	20
Fluorine	10	20
Formaldehyde (concentration ≥ 90 %)	5	50
Hydrogen	5	50
Hydrogen chloride (liquefied gas)	25	250
Lead alkyls	5	50
Liquefied extremely flammable gases (including LPG) and natural gas	50	200
Acetylene	5	50
Ethylene oxide	5	50
Propylene oxide	5	50
Methanol	500	5,000
4, 4-Methylenebis (2-chloraniline) and/or salts, in powder form	-	0.01
Methylisocyanate	-	0.15
Oxygen	200	2,000
Toluene diisocyanate	10	100
Carbonyl dichloride (phosgene)	0.3	0.75
Arsenic trihydride (arsine)	0.2	1
Phosphorus trihydride (phosphine)	0.2	1
Sulphur dichloride	1	1
Sulphur trioxide	15	75
Polychlorodibenzofurans and polychlorodibenzodioxins (including TCDD), calculated in TCDD equivalent	-	0.001
The following CARCINOGENS at concentrations above 5% by weight: 4-Aminobiphenyl and/or its salts, Benzotrichloride, Benzidine and/or salts, Bis (chloromethyl) ether, Chloromethyl methyl ether, 1,2-Dibromoethane, Diethyl sulphate, Dimethyl sulphate, Dimethylcarbamoyl chloride, 1,2-Dibromo-3-chloropropane, 1,2-Dimethylhydrazine, Dimethylnitrosamine, Hexamethylphosphoric triamide, Hydrazine, 2-Naphthylamine and/or salts, 4-Nitrodiphenyl, and 1,3 Propanesultone	0.5	2
Petroleum products: (a) gasolines and naphthas, (b) kerosenes (including jet fuels), (c) gas oils (including diesel fuels, home heating oils, and gas oil blending streams)	2,500	25,000

NOTES

1. Ammonium nitrate (5,000/10,000): fertilisers capable of self-sustaining decomposition

   This applies to ammonium nitrate-based compound/composite fertilisers (compound/composite fertilisers containing ammonium nitrate with phosphate and/or potash) in which the nitrogen content as a result of ammonium nitrate is:

   - between 15.75% ([1]) and 24.5% ([2]) by weight, and either with not more than 0.4% total combustible/organic materials or which fulfil the requirements of Annex II of Directive 80/876/EEC; and
   - 15.75% ([3]) by weight or less and unrestricted combustible materials, and which are capable of self-sustaining decomposition according to the UN Trough Test (see United Nations Recommendations on the Transport of Dangerous Goods: Manual of Tests and Criteria, Part III, subsection 38.2).

([1]) 15.75% nitrogen content by weight as a result of ammonium nitrate corresponds to 45% ammonium nitrate.
([2]) 24.5% nitrogen content by weight as a result of ammonium nitrate corresponds to 70% ammonium nitrate.
([3]) 15.75% nitrogen content by weight as a result of ammonium nitrate corresponds to 45% ammonium nitrate.

2. *Ammonium nitrate (1,250/5,000): fertiliser grade*

   This applies to straight ammonium nitrate-based fertilisers and to ammonium nitrate-based compound/composite fertilisers in which the nitrogen content as a result of ammonium nitrate is:

   - more than 24.5% by weight, except for mixtures of ammonium nitrate with dolomite, limestone and/or calcium carbonate with a purity of at least 90%;
   - more than 15.75% by weight for mixtures of ammonium nitrate and ammonium sulphate; and
   - more than 28% ([4]) by weight for mixtures of ammonium nitrate with dolomite, limestone and/or calcium carbonate with a purity of at least 90%, and which fulfil the requirements of Annex II of Directive 80/876/EEC.

([4]) 28% nitrogen content by weight as a result of ammonium nitrate corresponds to 80% ammonium nitrate.

3. *Ammonium nitrate (350/2,500): technical grade*

   This applies to:

   - ammonium nitrate and preparations of ammonium nitrate in which the nitrogen content as a result of the ammonium nitrate is:
     - between 24.5% and 28% by weight, and which contain not more than 0.4% combustible substances;
     - more than 28% by weight, and which contain not more than 0.2% combustible substances; and
   - aqueous ammonium nitrate solutions in which the concentration of ammonium nitrate is more than 80% by weight.

4. *Ammonium nitrate (10/50): 'off-specs' material and fertilisers not fulfilling the detonation test*

   This applies to:

   - material rejected during the manufacturing process and to ammonium nitrate and preparations of ammonium nitrate, straight ammonium nitrate-based fertilisers and ammonium nitrate-based compound/ composite fertilisers referred to in Notes 2 and 3, that are being or have been returned from the final user to a manufacturer, temporary storage or reprocessing plant for reworking, recycling or treatment for safe use, because they no longer comply with the specifications of Notes 2 and 3; and
   - fertilisers referred to in Note 1, first indent, and Note 2 which do not fulfil the requirements of Annex II of Directive 80/876/EEC.

5. *Potassium nitrate (5,000/10,000): composite potassium-nitrate based fertilisers composed of potassium nitrate in prilled/granular form*

6. *Potassium nitrate (1,250/5,000): composite potassium-nitrate based fertilisers composed of potassium nitrate in crystalline form*

7. *Polychlorodibenzofurans and polychlorodibenzodioxins*

   The quantities of polychlorodibenzofurans and polychlorodibenzodioxins are calculated using the following factors:

International Toxic Equivalent Factors (ITEF) for the congeners of concern (NATO/CCMS)			
2,3,7,8-TCDD	1	2,3,7,8-TCDF	0.1
1,2,3,7,8-PeDD	0.5	2,3,4,7,8-PeCDF	0.5
		1,2,3,7,8-PeCDF	0.05
1,2,3,4,7,8-HxCDD 1,2,3,6,7,8-HxCDD 1,2,3,7,8,9-HxCDD	0.1	1,2,3,4,7,8-HxCDF 1,2,3,7,8,9-HxCDF 1,2,3,6,7,8-HxCDF 2,3,4,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-HpCDD	0.01	1,2,3,4,6,7,8-HpCDF 1,2,3,4,7,8,9-HpCDF	0.01
OCDD	0.001	OCDF	0.001

(T = tetra, P = penta, Hx = hexa, HP = hepta, O = octa)

Part 2: Categories of substances and preparations not specifically named in Part 1

Column 1	Column 2	Column 3
Categories of dangerous substances	**Qualifying quantity (tonnes) of dangerous substances as delivered in Article 3 (4), for the application of:**	
	Articles 6 and 7	**Article 9**
1. VERY TOXIC	5	20
2. TOXIC	50	200
3. OXIDIZING	50	200
4. EXPLOSIVE (see Note 2) where the substance, preparation or article falls under UN/ADR Division 1.4	50	200
5. EXPLOSIVE (see Note 2) where the substance, preparation, or article falls under any of: UN/ADR Divisions 1.1, 1.2, 1.3, 1.5, or 1.6 or risk phrase R2 or R3	10	50
6. FLAMMABLE (where the substance or preparation falls within the definition given in Note 3 (a))	5,000	50,000
7 a. HIGHLY FLAMMABLE (where the substance or preparation falls within the definition given in Note 3 (b) (1))	50	200
7 b. HIGHLY FLAMMABLE liquids (where the substance or preparation falls within the definition given in Note 3 (b) (2))	5,000	50,000
8. EXTREMELY FLAMMABLE (where the substance or preparation falls within the definition given in Note 3 (c))	10	50
9. DANGEROUS FOR THE ENVIRONMENT risk phrases:		
(i) R50: 'Very toxic to aquatic organisms'(including R50/53)	100	200
(ii) R51/53: 'Toxic to aquatic organisms; may cause long term adverse effects in the aquatic environment'	200	500
10. ANY CLASSIFICATION not covered by those given above in combination with risk phrases:		
(i) R14: 'Reacts violenty with water' (including R14/15)	100	500
(ii) R29: 'in contact with water, liberates toxic gas'	50	200

NOTES

1. Substances and preparations are classified according to the following Directives and their current adaptation to technical progress:

   - Council Directive 67/548/EEC of 27 June 1967 on the approximation of the laws, regulations and administrative provisions relating to the classification, packaging, and labelling of dangerous substances ([1]).
   - Directive 1999/45/EC of the European Parliament and of the Council of 31 May 1999 concerning the approximation of laws, regulations, and administrative provisions of the Member States relating to the classification, packaging, and labelling of dangerous preparations ([2]).

   In the case of substances and preparations which are not classified as dangerous according to either of the above directives, for example waste, but which nevertheless are present, or are likely to be present, in an establishment and which possess or are likely to possess, under the conditions found at the establishment, equivalent properties in terms of major-accident potential, the procedures for provisional classification shall be followed in accordance with the relevant article of the appropriate Directive.

   In the case of substances and preparations with properties giving rise to more than one classification, for the purposes of this Directive the lowest qualifying quantities shall apply. However, for the application of the rule in Note 4, the qualifying quantity used shall always be the one corresponding to the classification concerned.

   For the purposes of this Directive, the Commission shall establish and keep up to date a list of substances which have been classified into the above categories by a harmonised Decision in accordance with Directive 67/548/EEC.

([1]) OJ 196, 16.8.1967, p. 1. Directive as last amended by Regulation (EC) No 807/2003 (OJ L 122, 16.5.2003, p. 36).
([2]) OJ L 200, 30.7.1999, p. 1. Directive as amended by Commission Directive 2001/60/EC (OJ L 226, 22.8.2001, p. 5).

2. An 'explosive' means:

   - a substance or preparation which creates the risk of an explosion by shock, friction, fire, or other sources of ignition (risk phrase R2);
   - a substance or preparation which creates extreme risks of explosion by shock, friction, fire, or other sources of ignition (risk phrase R3); or
   - a substance, preparation, or article covered by Class 1 of the European Agreement concerning the International Carriage of Dangerous Goods by Road (UN/ADR), concluded on 30 September 1957, as amended, as transposed by Council Directive 94/55/EC of 21 November 1994 on the approximation of the laws of the Member States with regard to the transport of dangerous goods by road ([1]).

   Included in this definition are pyrotechnics, which for the purposes of this Directive are defined as substances (or mixtures of substances) designated to produce heat, light, sound, gas, or smoke or a combination of such effects through self-sustained exothermic chemical reactions. Where a substance or preparation is classified by both UN/ADR and risk phase R2 or R3, the UN/ADR classification shall take precedence over assignment of risk phrases.

   Substances and articles of Class 1 are classified in any of the divisions 1.1 to 1.6 in accordance with the UN/ADR classification scheme. The divisions concerned are:

   Division 1.1: 'Substances and articles which have a mass explosion hazard (a mass explosion is an explosion which affects almost the entire load virtually instantaneously).'

   Division 1.2: 'Substances and articles which have a projection hazard but not a mass explosion hazard.'

   Division 1.3: 'Substances and articles which have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard:

   (a) combustion of which gives rise to considerable radiant heat; or

   (b) which burn one after another, producing minor blast or projection effects or both.'

   Division 1.4: 'Substances and articles which present only a slight risk in the event of ignition or initiation during carriage. The effects are largely confined to the package and no projection of fragments of appreciable size or range is to be expected. An external fire shall not cause virtually instantaneous explosion of virtually the entire contents of the package.'

   Division 1.5: 'Very insensitive substances having a mass explosion hazard which are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions of carriage. As a minimum requirement they shall not explode in the external fire test.'

   Division 1.6: 'Extremely insensitive articles which do not have a mass explosion hazard. The articles contain only extremely insensitive detonating substances and demonstrate a negligible probability of accidental initiation or propagation. The risk is limited to the explosion of a single article.'

   Included in this definition are also explosive or pyrotechnic substances or preparations contained in articles. In the case of articles containing explosive or pyrotechnic substances or preparations, if the quantity of the substance or preparation contained is known, that quantity shall be considered for the purposes of this Directive. If the quantity is not known, then, for the purposes of this Directive, the whole article shall be treated as explosive.

([1]) OJ L 319, 12.12.1994, p. 7. Directive as last amended by Commission Directive 2003/ 28/EC (OJ L 90, 8.4.2003, p. 45).

3. 'Flammable,' 'highly flammable,' and 'extremely flammable,' in categories 6, 7, and 8 mean:

   (a) flammable liquids:

   – substances and preparations having a flash point equal to or greater than 21 °C and less than or equal to 55 °C (risk phrase R 10), supporting combustion;

   (b) highly flammable liquids:

   – substances and preparations which may become hot and finally catch fire in contact with air at ambient temperature without any input of energy (risk phrase R 17);
   – substances and preparations which have a flash point lower than 55 °C and which remain liquid under pressure, where particular processing conditions, such as high pressure or high temperature, may create major-accident hazards;
   – substances and preparations having a flash point lower than 21 °C and which are not extremely flammable (risk phrase R 11, second indent);

(c) extremely flammable gases and liquids:

- liquid substances and preparations which have a flash point lower than 0 °C and the boiling point (or, in the case of a boiling range, the initial boiling point) of which at normal pressure is less than or equal to 35 °C (risk phrase R 12, first indent);
- gases which are flammable in contact with air at ambient temperature and pressure (risk phrase R12, second indent), which are in a gaseous or supercritical state; and
- flammable and highly flammable liquid substances and preparations maintained at a temperature above their boiling point.

4. In the case of an establishment where no individual substance or preparation is present in a quantity above or equal to the relevant qualifying quantities, the following rule shall be applied to determine whether the establishment is covered by the relevant requirements of this Directive.

This Directive shall apply if the sum q1/QU1 + q2/QU2 + q3/QU3 + q4/QU4 + q5/QU5 +… is greater than or equal to 1, where qx = the quantity of dangerous substance x (or category of dangerous substances) falling within Parts 1 or 2 of this Annex, and QUX = the relevant qualifying quantity for substance or category x from column 3 of Parts 1 or 2.

This Directive shall apply, with the exception of Articles 9, 11, and 13, if the sum q1/QL1 + q2/QL2 + q3/QL3 + q4/QL4 + q5/QL5 +… is greater than or equal to 1, where qx = the quantity of dangerous substance x (or category of dangerous substances) falling within Parts 1 or 2 of this Annex, and QLX = the relevant qualifying quantity for substance or category x from column 2 of Parts 1 or 2.

This rule shall be used to assess the overall hazards associated with toxicity, flammability, and eco-toxicity. It must therefore be applied three times:

(a) for the addition of substances and preparations named in Part 1 and classified as toxic or very toxic, together with substances and preparations falling into categories 1 or 2;

(b) for the addition of substances and preparations named in Part 1 and classified as oxidising, explosive, flammable, highly flammable, or extremely flammable, together with substances and preparations falling into categories 3, 4, 5, 6, 7a, 7b, or 8; and

(c) for the addition of substances and preparations named in Part 1 and classified as dangerous for the environment (R50 [including R50/53] or R51/53), together with substances and preparations falling into categories 9(i) or 9(ii).

The relevant provisions of this Directive apply if any of the sums obtained by (a), (b) or (c) is greater than or equal to 1.

b. UNITED STATES: LIST OF CHEMICALS and THRESHOLDS
Risk Management Plan (RMP) Program

The United States has several different lists related to chemical accident prevention and preparedness, depending on the purpose of the list and the associated laws (*e.g.*, there is a different list for prevention activities, another list for certain preparedness activities, etc.) There is substantial overlap between these lists and the US has created a "list of lists" comparing the chemicals and thresholds on these lists. See: www.epa.gov/emergencies.

The following are the lists related to the RMP Program:

PART 68 – Chemical Accident Prevention Provisions–Table of Contents

Subpart F – Regulated Substances for Accidental Release Prevention

Sec. 68.130 List of substances:

a. Regulated toxic and flammable substances under section 112(r) of the Clean Air Act are the substances listed in Tables 1, 2, 3, and 4. Threshold quantities for listed toxic and flammable substances are specified in the tables.
b. The basis for placing toxic and flammable substances on the list of regulated substances are explained in the notes to the list.

Table 1 to Sec. 68.130:
List of Regulated Toxic Substances and Threshold Quantities for Accidental Release Prevention
[Alphabetical Order – 77 Substances]

Chemical name	CAS No.	Threshold quantity (lbs)	Basis for listing
Acrolein [2-Propenal]	107-02-8	5,000	b
Acrylonitrile [2-Propenenitrile]	107-13-1	20,000	b
Acrylyl chloride [2-Propenoyl chloride]	814-68-6	5,000	b
Allyl alcohol [2-Propen-l-ol]	107-18-61	15,000	b
Allylamine [2-Propen-l-amine]	107-11-9	10,000	b
Ammonia (anhydrous)	7664-41-7	10,000	a, b
Ammonia (conc 20% or greater)	7664-41-7	20,000	a, b
Arsenous trichloride	7784-34-1	15,000	b
Arsine	7784-42-1	1,000	b
Boron trichloride [Borane, trichloro-]	10294-34-5	5,000	b
Boron trifluoride [Borane, trifluoro-]	7637-07-2	5,000	b
Boron trifluoride compound with methyl ether (1:1) [Boron, trifluoro [oxybis [metane]]-, T-4-	353-42-4	15,000	b
Bromine	7726-95-6	10,000	a, b
Carbon disulfide	75-15-0	20,000	b
Chlorine	7782-50-5	2,500	a, b
Chlorine dioxide [Chlorine oxide (ClO2)]	10049-04-4	1,000	c
Chloroform [Methane, trichloro-]	67-66-3	20,000	b
Chloromethyl ether [Methane, oxybis[chloro-]	542-88-1	1,000	b
Chloromethyl methyl ether [Methane, chloromethoxy-]	107-30-2	5,000	b
Crotonaldehyde [2-Butenal]	4170-30-3	20,000	b
Crotonaldehyde, (E)- [2-Butenal, (E)-]	123-73-9	20,000	b
Cyanogen chloride	506-77-4	10,000	c
Cyclohexylamine [Cyclohexanamine]	108-91-8	15,000	b
Diborane	19287-45-7	2,500	b

Table 1 to Sec. 68.130: List of Regulated Toxic Substances and Threshold Quantities for Accidental Release Prevention *(continued)*

Chemical name	CAS No.	Threshold quantity (lbs)	Basis for listing
Dimethyldichlorosilane [Silane, dichlorodimethyl-]	75-78-5	5,000	b
1,1-Dimethylhydrazine [Hydrazine, 1,1-dimethyl-]	57-14-7	15,000	b
Epichlorohydrin [Oxirane, (chloromethyl)-]	106-89-8	20,000	b
Ethylenediamine [1,2- Ethanediamine]	107-15-3	20,000	b
Ethyleneimine [Aziridine]	151-56-4	10,000	b
Ethylene oxide [Oxirane]	75-21-8	10,000	a, b
Fluorine	7782-41-4	1,000	b
Formaldehyde (solution)	50-00-0	15,000	b
Furan	110-00-9	5,000	b
Hydrazine	302-01-2	15,000	b
Hydrochloric acid (conc 37% or greater)	7647-01-0	15,000	d
Hydrocyanic acid	74-90-8	2,500	a, b
Hydrogen chloride (anhydrous) [Hydrochloric acid]	7647-01-0	5,000	a
Hydrogen fluoride/Hydrofluoric acid (conc 50% or greater) [Hydrofluoric acid]	7664-39-3	1,000	a, b
Hydrogen selenide	7783-07-5	500	b
Hydrogen sulfide	7783-06-4	10,000	a, b
Iron, pentacarbonyl-[Iron carbonyl (Fe(CO)5), (TB-5-11)-]	13463-40-6	2,500	b
Isobutyronitrile [Propanenitrile, 2-methyl-]	78-82-0	20,000	b
Isopropyl chloroformate [Carbonochloridic acid, 1- methylethyl ester]	108-23-6	15,000	b
Methacrylonitrile [2-Propenenitrile, 2-methyl-]	126-98-7	10,000	b
Methyl chloride [Methane, chloro-]	74-87-3	10,000	a
Methyl chloroformate [Carbonochloridic acid, methylester]	79-22-1	5,000	b
Methyl hydrazine [Hydrazine, methyl-]	60-34-4	15,000	b
Methyl isocyanate [Methane, isocyanato-]	624-83-9	10,000	a, b
Methyl mercaptan [Methanethiol]	74-93-1	10,000	b
Methyl thiocyanate [Thiocyanic acid, methyl ester]	556-64-9	20,000	b
Methyltrichlorosilane [Silane, trichloromethyl-]	75-79-6	5,000	b
Nickel carbonyl	13463-39-3	1,000	b
Nitric acid (conc 80% or greater)	7697-37-2	15,000	b
Nitric oxide [Nitrogen oxide (NO)]	10102-43-9	10,000	b
Oleum (Fuming Sulfuric acid) [Sulfuric acid, mixture with sulfur trioxide] ([1])	8014-95-7	10,000	e
Peracetic acid [Ethaneperoxoic acid]	79-21-0	10,000	b
Perchloromethylmercaptan [Methanesulfenyl chloride, trichloro-]	594-42-3	10,000	b
Phosgene [Carbonic dichloride]	75-44-5	500	a, b
Phosphine	7803-51-2	5,000	b
Phosphorus oxychloride [Phosphoryl chloride]	10025-87-3	5,000	b
Phosphorus trichloride [Phosphorous trichloride]	7719-12-2	15,000	b
Piperidine	110-89-4	15,000	b
Propionitrile [Propanenitrile]	107-12-0	10,000	b
Propyl chloroformate [Carbonochloridic acid, propylester]	109-61-5	15,000	b
Propyleneimine [Aziridine, 2-methyl-]	75-55-8	10,000	b
Propylene oxide [Oxirane, methyl-]	75-56-9	10,000	b
Sulfur dioxide (anhydrous)	7446-09-5	5,000	a, b
Sulfur tetrafluoride [Sulfur fluoride (SF4), (T-4)-]	7783-60-0	2,500	b

Table 1 to Sec. 68.130: List of Regulated Toxic Substances and Threshold Quantities for Accidental Release Prevention *(continued)*

Chemical name	CAS No.	Threshold quantity (lbs)	Basis for listing
Sulfur trioxide	7446-11-9	10,000	a, b
Tetramethyllead [Plumbane, tetramethyl-]	75-74-1	10,000	b
Tetranitromethane [Methane, tetranitro-]	509-14-8	10,000	b
Titanium tetrachloride [Titanium chloride (TiCl4) (T-4)-]	7550-45-0	2,500	b
Toluene 2,4-diisocyanate [Benzene, 2,4-diisocyanato-1-methyl-] (1)	584-84-9	10,000	a
Toluene 2,6-diisocyanate [Benzene, 1,3-diisocyanato-2-methyl-] (1)	91-08-7	10,000	a
Toluene diisocyanate (unspecified isomer) [Benzene,1,3-diisocyanatomethyl-] (1)	26471-62-5	10,000	a
Trimethylchlorosilane [Silane, chlorotrimethyl-]	75-77-4	10,000	b
Vinyl acetate monomer [Acetic acid ethenyl ester]	108-05-4	15,000	b

(1) The mixture exemption in Sec. 68.115(b)(1) does not apply to the substance.

Note: Basis for Listing:

a. Mandated for listing by Congress.
b. On EHS list, vapor pressure 10 mmHg or greater.
c. Toxic gas.
d. Toxicity of hydrogen chloride, potential to release hydrogen chloride, and history of accidents.
e. Toxicity of sulfur trioxide and sulfuric acid, potential to release sulfur trioxide, and history of accidents.

Table 2 to Sec. 68.130:
List of Regulated Toxic Substances and Threshold Quantities for Accidental Release Prevention
[CAS Number Order – 77 Substances]

CAS No.	Chemical name	Threshold quantity (lbs)	Basis for listing
50-00-0	Formaldehyde (solution)	15,000	b
57-14-7	1,1-Dimethylhydrazine [Hydrazine, 1,1-dimethyl-]	15,000	b
60-34-4	Methyl hydrazine [Hydrazine, methyl-]	15,000	b
67-66-3	Chloroform [Methane, trichloro-]	20,000	b
74-87-3	Methyl chloride [Methane, chloro-]	10,000	a
74-90-8	Hydrocyanic acid	2,500	a, b
74-93-1	Methyl mercaptan [Methanethiol]	10,000	b
75-15-0	Carbon disulfide	20,000	b
75-21-8	Ethylene oxide [Oxirane]	10,000	a, b
75-44-5	Phosgene [Carbonic dichloride]	500	a, b
75-55-8	Propyleneimine [Aziridine, 2-methyl-]	10,000	b
75-56-9	Propylene oxide [Oxirane, methyl-]	10,000	b
75-74-1	Tetramethyllead [Plumbane,tetramethyl-]	10,000	b
75-77-4	Trimethylchlorosilane [Silane,chlorotrimethyl-]	10,000	b
75-78-5	Dimethyldichlorosilane [Silane, dichlorodimethyl-]	5,000	b
75-79-6	Methyltrichlorosilane [Silane, trichloromethyl-]	5,000	b
78-82-0	Isobutyronitrile [Propanenitrile, 2-methyl-]	20,000	b
79-21-0	Peracetic acid [Ethaneperoxoic acid]	10,000	b
79-22-1	Methyl chloroformate [Carbonochloridic acid, methylester]	5,000	b
91-08-7	Toluene 2,6-diisocyanate [Benzene, 1,3- diisocyanato-2-methyl-](1)	10,000	a

Table 2 to Sec. 68.130: List of Regulated Toxic Substances and Threshold Quantities for Accidental Release Prevention *(continued)*

CAS No.	Chemical name	Threshold quantity (lbs)	Basis for listing
106-89-8	Epichlorohydrin [Oxirane, (chloromethyl)-]	20,000	b
107-02-8	Acrolein [2-Propenal]	5,000	b
107-11-9	Allylamine [2-Propen-1-amine]	10,000	b
107-12-0	Propionitrile [Propanenitrile]	10,000	b
107-13-1	Acrylonitrile [2-Propenenitrile]	20,000	b
107-15-3	Ethylenediamine [1,2-Ethanediamine]	20,000	b
107-18-6	Allyl alcohol [2-Propen-1-ol]	15,000	b
107-30-2	Chloromethyl methyl ether [Methane, chloromethoxy-]	5,000	b
108-05-4	Vinyl acetate monomer [Acetic acid ethenyl ester]	15,000	b
108-23-6	Isopropyl chloroformate [Carbonochloridic acid, 1-methylethyl ester]	15,000	b
108-91-8	Cyclohexylamine [Cyclohexanamine]	15,000	b
109-61-5	Propyl chloroformate [Carbonochloridic acid, propylester]	15,000	b
110-00-9	Furan	5,000	b
110-89-4	Piperidine	15,000	b
123-73-9	Crotonaldehyde, (E)-[2-Butenal, (E)-]	20,000	b
126-98-7	Methacrylonitrile [2-Propenenitrile, 2-methyl-]	10,000	b
151-56-4	Ethyleneimine [Aziridine]	10,000	b
302-01-2	Hydrazine	15,000	b
353-42-4	Boron trifluoride compound with methyl ether (1:1) [Boron, trifluoro[oxybis[methane]]-, T-4-	15,000	b
506-77-4	Cyanogen chloride	10,000	c
509-14-8	Tetranitromethane [Methane, tetranitro-]	10,000	b
542-88-1	Chloromethyl ether [Methane, oxybis[chloro-]	1,000	b
556-64-9	Methyl thiocyanate [Thiocyanic acid, methyl ester]	20,000	b
584-84-9	Toluene 2,4-diisocyanate [Benzene, 2,4-diisocyanato-1-methyl-](1)	10,000	a
594-42-3	Perchloromethylmercapt an [Methanesulfenyl chloride, trichloro-]	10,000	b
624-83-9	Methyl isocyanate [Methane, isocyanato-]	10,000	a, b
814-68-6	Acrylyl chloride [2-Propenoyl chloride]	5,000	b
4170-30-3	Crotonaldehyde [2-Butenal]	20,000	b
7446-09-5	Sulfur dioxide (anhydrous)	5,000	a, b
7446-11-9	Sulfur trioxide	10,000	a, b
7550-45-0	Titanium tetrachloride [Titanium chloride (TiCl4) (T-4)-]	2,500	b
7637-07-2	Boron trifluoride[Borane, trifluoro-]	5,000	b
7647-01-0	Hydrochloric acid (conc 37% or greater)	15,000	d
7647-01-0	Hydrogen chloride(anhydrous) [Hydrochloric acid]	5,000	a
7664-39-3	Hydrogen fluoride/Hydrofluoric acid (conc 50% or greater) [Hydrofluoric acid]	1,000	a, b
7664-41-7	Ammonia (anhydrous)	10,000	a, b
7664-41-7	Ammonia (conc 20% or greater)	20,000	a, b
7697-37-2	Nitric acid (conc 80% or greater)	15,000	b
7719-12-2	Phosphorus trichloride [Phosphorous trichloride]	15,000	b
7726-95-6	Bromine	10,000	a, b
7782-41-4	Fluorine	1,000	b
7782-50-5	Chlorine	2,500	a, b
7783-06-4	Hydrogen sulfide	10,000	a, b

Table 2 to Sec. 68.130: List of Regulated Toxic Substances and Threshold Quantities for Accidental Release Prevention *(continued)*

CAS No.	Chemical name	Threshold quantity (lbs)	Basis for listing
7783-07-5	Hydrogen selenide	500	b
7783-60-0	Sulfur tetrafluoride [Sulfur fluoride (SF4), (T-4)-]	2,500	b
7784-34-1	Arsenous trichloride	15,000	b
7784-42-1	Arsine	1,000	b
7803-51-2	Phosphine	5,000	b
8014-95-7	Oleum (Fuming Sulfuric acid) [Sulfuric acid, mixture with sulfur trioxide](1)	10,000	e
10025-87-3	Phosphorus oxychloride [Phosphoryl chloride]	5,000	b
10049-04-4	Chlorine dioxide [Chlorine oxide ClO2)]	1,000	c
10102-43-9	Nitric oxide [Nitrogenoxide (NO)]	10,000	b
10294-34-5	Boron trichloride [Borane, trichloro-]	5,000	b
13463-39-3	Nickel carbonyl	1,000	b
13463-40-6	Iron, pentacarbonyl-[Iron carbonyl (Fe(CO)5), (TB-5-11)-]	2,500	b
19287-45-7	Diborane	2,500	b
26471-62-5	Toluene diisocyanate (unspecified isomer) [Benzene, 1,3-diisocyanatomethyl-1](1)	10,000	a

(1) The mixture exemption in Sec. 68.115(b)(1) does not apply to the substance.

Note: Basis for Listing:

a. Mandated for listing by Congress.
b. On EHS list, vapor pressure 10 mmHg or greater.
c. Toxic gas.
d. Toxicity of hydrogen chloride, potential to release hydrogen chloride, and history of accidents.
e. Toxicity of sulfur trioxide and sulfuric acid, potential to release sulfur trioxide, and history of accidents.

Table 3 to Sec. 68.130:
List of Regulated Flammable Substances (1) and Threshold Quantities for Accidental Release Prevention
[Alphabetical Order – 63 Substances]

Chemical name	CAS No.	Threshold quantity (lbs)	Basis for listing
Acetaldehyde	75-07-0	10,000	g
Acetylene [Ethyne]	74-86-2	10,000	f
Bromotrifluorethylene [Ethene, bromotrifluoro-]	598-73-2	10,000	f
1,3-Butadiene	106-99-0	10,000	f
Butane	106-97-8	10,000	f
1-Butene	106-98-9	10,000	f
2-Butene	107-01-7	10,000	f
Butene	25167-67-3	10,000	f
2-Butene-cis	590-18-1	10,000	f
2-Butene-trans [2-Butene, (E)]	624-64-6	10,000	f
Carbon oxysulfide [Carbon oxide sulfide (COS)]	463-58-1	10,000	f
Chlorine monoxide [Chlorine oxide]	7791-21-1	10,000	f
2-Chloropropylene [1-Propene, 2-chloro-]	557-98-2	10,000	g
1-Chloropropylene [1-Propene, 1-chloro-]	590-21-6	10,000	g
Cyanogen [Ethanedinitrile]	460-19-5	10,000	f
Cyclopropane	75-19-4	10,000	f

Table 3 to Sec. 68.130: List of Regulated Flammable Substances ([1]) and Threshold Quantities for Accidental Release Prevention *(continued)*

Chemical name	CAS No.	Threshold quantity (lbs)	Basis for listing
Dichlorosilane [Silane, dichloro-]	4109-96-0	10,000	f
Difluoroethane [Ethane, 1,1-difluoro-]	75-37-6	10,000	f
Dimethylamine [Methanamine, N-methyl-]	124-40-3	10,000	f
2,2-Dimethylpropane [Propane, 2,2-dimethyl-]	463-82-1	10,000	f
Ethane	74-84-0	10,000	f
Ethyl acetylene [1-Butyne]	107-00-6	10,000	f
Ethylamine [Ethanamine]	75-04-7	10,000	f
Ethyl chloride [Ethane, chloro-]	75-00-3	10,000	f
Ethylene [Ethene]	74-85-1	10,000	f
Ethyl ether [Ethane, 1,1'-oxybis-]	60-29-7	10,000	g
Ethyl mercaptan [Ethanethiol]	75-08-1	10,000	g
Ethyl nitrite [Nitrous acid, ethyl ester]	109-95-5	10,000	f
Hydrogen	1333-74-0	10,000	f
Isobutane [Propane, 2-methyl]	75-28-5	10,000	f
Isopentane [Butane, 2-methyl-]	78-78-4	10,000	g
Isoprene [1,3-Butadinene, 2-methyl-]	78-79-5	10,000	g
Isopropylamine [2-Propanamine]	75-31-0	10,000	g
Isopropyl chloride [Propane, 2-chloro-]	75-29-6	10,000	g
Methane	74-82-8	10,000	f
Methylamine [Methanamine]	74-89-5	10,000	f
3-Methyl-1-butene	563-45-1	10,000	f
2-Methyl-1-butene	563-46-2	10,000	g
Methyl ether [Methane, oxybis-]	115-10-6	10,000	f
Methyl formate [Formic acid, methyl ester]	107-31-3	10,000	g
2-Methylpropene [1-Propene, 2-methyl-]	115-11-7	10,000	f
1,3-Pentadinene	504-60-9	10,000	f
Pentane	109-66-0	10,000	g
1-Pentene	109-67-1	10,000	g
2-Pentene, (E)-	646-04-8	10,000	g
2-Pentene, (Z)-	627-20-3	10,000	g
Propadiene [1,2-Propadiene]	463-49-0	10,000	f
Propane	74-98-6	10,000	f
Propylene [1-Propene]	115-07-1	10,000	f
Propyne [1-Propyne]	74-99-7	10,000	f
Silane	7803-62-5	10,000	f
Tetrafluoroethylene [Ethene, tetrafluoro-]	116-14-3	10,000	f
Tetramethylsilane [Silane, tetramethyl-]	75-76-3	10,000	g
Trichlorosilane [Silane, trichloro-]	10025-78-2	10,000	g
Trifluorochloroethylene [Ethene, chlorotrifluoro-]	79-38-9	10,000	f
Trimethylamine [Methanamine, N,N-dimethyl-]	75-50-3	10,000	f
Vinyl acetylene [1-Buten-3-yne]	689-97-4	10,000	f
Vinyl chloride [Ethene, chloro-]	75-01-4	10,000	a, f
Vinyl ethyl ether [Ethene,ethoxy-]	109-92-2	10,000	g
Vinyl fluoride [Ethene, fluoro-]	75-02-5	10,000	f

Table 3 to Sec. 68.130: List of Regulated Flammable Substances (1) and Threshold Quantities for Accidental Release Prevention *(continued)*

Chemical Name	CAS No.	Threshold Quantity (lbs)	Basis for Listing
Vinylidene chloride [Ethene, 1,1-dichloro-]	75-35-4	10,000	g
Vinylidene fluoride [Ethene, 1,1-difluoro-]	75-38-7	10,000	f
Vinyl methyl ether [Ethene, methoxy-]	107-25-5	10,000	f

(1) A flammable substance when used as a fuel or held for sale as a fuel at a retail facility is excluded from all provisions of this part (see Sec. 68.126).

Note: Basis for Listing:

a. Mandated for listing by Congress.
f. Flammable gas.
g. Volatile flammable liquid.

Table 4 to Sec. 68.130:
List of Regulated Flammable Substances (1) and Threshold Quantities for Accidental Release Prevention
[CAS Number Order – 63 Substances]

CAS No.	Chemical Name	Threshold Quantity (lbs)	Basis for Listing
60-29-7	Ethyl ether [Ethane, 1,1'-oxybis-]	10,000	g
74-82-8	Methane	10,000	f
74-84-0	Ethane	10,000	f
74-85-1	Ethylene [Ethene]	10,000	f
74-86-2	Acetylene [Ethyne]	10,000	f
74-89-5	Methylamine [Methanamine]	10,000	f
74-98-6	Propane	10,000	f
74-99-7	Propyne [1-Propyne]	10,000	f
75-00-3	Ethyl chloride [Ethane, chloro-]	10,000	f
75-01-4	Vinyl chloride [Ethene, chloro-]	10,000	a, f
75-02-5	Vinyl fluoride [Ethene, fluoro-]	10,000	f
75-04-7	Ethylamine [Ethanamine]	10,000	f
75-07-0	Acetaldehyde	10,000	g
75-08-1	Ethyl mercaptan [Ethanethiol]	10,000	g
75-19-4	Cyclopropane	10,000	f
75-28-5	Isobutane [Propane, 2-methyl]	10,000	f
75-29-6	Isopropyl chloride [Propane,chloro-]	10,000	g
75-31-0	Isopropylamine [2-Propanamine]	10,000	g
75-35-4	Vinylidene chloride [Ethene,1,1-dichloro-]	10,000	g
75-37-6	Difluoroethane [Ethane, 1,1-difluoro-]	10,000	f
75-38-7	Vinylidene fluoride [Ethene,1,1-difluoro-]	10,000	f
75-50-3	Trimethylamine [Methanamine, N, N-dimethyl-]	10,000	f
75-76-3	Tetramethylsilane [Silane,tetramethyl-]	10,000	g
78-78-4	Isopentane [Butane, 2-methyl-]	10,000	g
78-79-5	Isoprene [1,3,-Butadiene, 2-methyl-]	10,000	g
79-38-9	Trifluorochloroethylene[Ethene, chlorotrifluoro-]	10,000	f
106-97-8	Butane	10,000	f
106-98-9	1-Butene	10,000	f
196-99-0	1,3-Butadiene	10,000	f

Table 4 to Sec. 68.130: List of Regulated Flammable Substances ([1]) and Threshold Quantities for Accidental Release Prevention *(continued)*

CAS No.	Chemical Name	Threshold Quantity (lbs)	Basis for Listing
107-00-6	Ethyl acetylene [1-Butyne]	10,000	f
107-01-7	2-Butene	10,000	f
107-25-5	Vinyl methyl ether [Ethene, methoxy-]	10,000	f
107-31-3	Methyl formate [Formic acid, methyl ester]	10,000	g
109-66-0	Pentane	10,000	g
109-67-1	1-Pentene	10,000	g
109-92-2	Vinyl ethyl ether [Ethene, ethoxy-]	10,000	g
109-95-5	Ethyl nitrite [Nitrous acid, ethyl ester]	10,000	f
115-07-1	Propylene [1-Propene]	10,000	f
115-10-6	Methyl ether [Methane, oxybis-]	10,000	f
115-11-7	2-Methylpropene [1-Propene, 2-methyl-]	10,000	f
116-14-3	Tetrafluoroethylene [Ethene, tetrafluoro-]	10,000	f
124-40-3	Dimethylamine [Methanamine, N-methyl-]	10,000	f
460-19-5	Cyanogen [Ethanedinitrile]	10,000	f
463-49-0	Propadiene [1,2-Propadiene]	10,000	f
463-58-1	Carbon oxysulfide [Carbon oxide sulfide (COS)]	10,000	f
463-82-1	2,2-Dimethylpropane [Propane, 2,2-dimethyl-]	10,000	f
504-60-9	1,3-Pentadiene	10,000	f
557-98-2	2-Chloropropylene [1-Propene, 2-chloro-]	10,000	g
563-45-1	3-Methyl-1-butene	10,000	f
563-46-2	2-Methyl-1-butene	10,000	g
590-18-1	2-Butene-cis	10,000	f
590-21-6	1-Chloropropylene [1-Propene, 1-chloro-]	10,000	g
598-73-2	Bromotrifluorethylene [Ethene,bromotrifluoro-]	10,000	f
624-64-6	2-Butene-trans [2-Butene, (E)]	10,000	f
627-20-3	2-Pentene, (Z)-	10,000	g
646-04-8	2-Pentene, (E)-	10,000	g
689-97-4	Vinyl acetylene [1-Buten-3-yne]	10,000	f
1333-74-0	Hydrogen	10,000	f
4109-96-0	Dichlorosilane [Silane,dichloro-]	10,000	f
7791-21-1	Chlorine monoxide [Chlorine oxide]	10,000	f
7803-62-5	Silane	10,000	f
10025-78-2	Trichlorosilane [Silane,trichloro-]	10,000	g
25167-67-3	Butene	10,000	f

([1]) A flammable substance when used as a fuel or held for sale as a fuel at a retail facility is excluded from all provisions of this part (see Sec. 68.126).

Note: Basis for Listing:

a. Mandated for listing by Congress.
f. Flammable gas.
g. Volatile flammable liquid.

[59 FR 4493, Jan. 31, 1994. Redesignated at 61 FR 31717, June 20, 1996, as amended at 62 FR 45132, Aug. 25, 1997; 63 FR 645, Jan. 6, 1998; 65 FR 13250, Mar. 13, 2000]

c. SWITZERLAND: CRITERIA FOR THRESHOLDS AND LIST OF EXCEPTIONS
Ordinance on "Protection against Major Accidents" (MAO, 1991)

The Swiss Ordinance on Protection against Major Accidents[39] (MAO) is built upon the concept of hazard potential, which is determined by the properties of the hazardous substance (product or waste) and the quantity of the substance on-site. The threshold values are determined using criteria provided in the MAO, which take into consideration the chemicals' properties (such as toxicity or flashpoint values).

The criteria are based on the following three properties of the substance: toxicity; fire/explosion characteristics; and ecotoxicity. If a substance exhibits multiple hazardous characteristics (for example, it is both toxic and flammable), then a threshold value is determined using the process for each relevant hazard characteristic, and the lowest threshold value is used. The tables below show the criteria provided in Appendix I of the MAO for determining thresholds.[40] The criteria for each property are listed from highest to lowest priority: *i.e.*, if criteria a is available, then the threshold is determined using criteria a and the remaining criteria do not need to be used. However, if criteria a is unavailable for a given chemical, then criteria b can be used to determine the threshold.

Toxicity				
Threshold	**200 kg**	**2,000 kg**	**20,000 kg**	**200,000 kg**
	⬆	⬆	⬆	⬆
a. EU-Classification	T+	T,C	Xn	Xi
b. acute toxicity – oral (mg/kg)	< 25	25 to ≤ 200	200 to ≤ 2000	
– dermal (mg/kg)	< 50	50 to ≤ 400	400 to ≤ 2000	
– inhalation (mg/l 4h)	< 0,5	0,5 to ≤ 2	2 to ≤ 20	
c. SDR(1) classification – Kl. 8		VG(2) I, II		VG(2) III
– Kl. 6.1	VG(2) I	VG(2) II	VG(2) III	

(1) Swiss Ordinance for the transportation of hazardous substances by road (almost identical to the ADR for international transport by road)
(2) VG = packaging group

Fire and Explosion Characteristics				
Threshold	**200 kg**	**2,000 kg**	**20,000 kg**	**200,000 kg**
	⬆	⬆	⬆	⬆
a. Fire risk according to SI(1)	T+	E1	E2, AF, HF, F1, F2, O1, O2	F3, F4, O3
b. EU-Classification		E	F+, F, O, R10	
c. Flash point °C			≤ 55	> 55
d. SDR(2) classification – Kl. 3			VG(3) I, II	VG(3) III

(1) Sicherheitsinstitut = Safety Institute, same classification system as used by the European Insurance and Reinsurance Federation (CEA); www.cea.eu
(2) Swiss Ordinance for the transportation of hazardous substances by road (almost identical to the ADR for international transport by road)
(3) VG = packaging group

[39]The full text of the MAO is available in English at: http://www.admin.ch/ch/e/rs/c814_012.html.

[40]An official list of substances and products (including CAS-number) with thresholds developed using the given criteria can be accessed in French at: http://www.bafu.admin.ch/publikationen/publikation/00010/index.html?lang=fr.

Ecotoxicity				
Threshold	**200 kg**	**2,000 kg**	**20,000 kg**	**200,000 kg**
	↑	↑	↑	↑
a. acute toxicity for daphnia: EC50(1) (mg/l) after one day		≤ 10		
b. acute toxicity for fish:(2) LC50(3) (mg/l) after two to four days		≤ 10		

(1) Median effective concentration for the loss of swimming ability for 50% the daphnia
(2) The requirements of the animal protection laws have to be respected
(3) Median lethal concentration

Annexe I of the MAO also contains a list of exceptions to the above described processes. It contains higher thresholds for some petroleum products (gasoline, heating oil/diesel, and kerosene), since they are widely used in large quantities and there is extensive experience in the management of such chemicals. Other exceptions include a lower threshold for chlorine and adjusted thresholds for chemicals that are governed more strictly in EU regulations. These substances, and their associated threshold limits, are listed in the table below.

List of Exceptions in the Swiss OMA (Annex 1)			
No.	**Substance Name**	**CAS Nr.(1)**	**Threshold (kg)**
1	Acetylene	74-86-2	5,000
2	4-Aminodiphenyl and its salts		1
3	Arsenious(III) oxide, Arsenic(III) acid and their salts		100
4	Arsenic(V) oxide, Arsenic(V) acid and/or their salts		1 000
5	Benzidine and its salts		1
6	Gasoline (Normal gasoline, Super gasoline)		200,000
7	Bis (chloromethyl) ether	542-88-1	1
8	Chlorine	7782-50-5	200
9	Chloromethyl methyl ether	107-30-2	1
10	Dimethylcarbamoyl chloride	79-44-7	1
11	Dimethyl nitrosamine	62-75-9	1
12	Heating oil, Diesel		500,000
13	Hexamethylphosphoric triamide	680-31-9 1	
14	Kerosene		200,000
15	4,4”-Methylen-bis (2-chloraniline) and its salts, in powder form		10
16	2-Naphthylamine and its salts		1
17	Nickel compounds in inhalable powder form (nickel monoxide, nickel dioxide, nickel sulphide, trinickel sulphide, dinickel trioxide)		1,000
18	4-Nitrodiphenyl	92-93-3	1
19	Methylisocyanate	624-83-9	150
20	Polychlordibenzofurans, calculated in TCDD-equivalent		1
21	Polychlorodibenzodioxins (including TCDD), calculated in TCDD-equivalent		1
22	1,3-Propansulton	1120-71-4	1
23	Sulphur dichloride	10545-99-0	1,000
24	Hydrogen	1333-74-0	5,000

(1) Identification number of a substance in the Chemical Abstract System

d. KOREA: LIST OF CHEMICALS and THRESHOLDS
Industrial Safety and Health Law (amended Jan 5, 1995)

Hazardous Materials and Threshold Quantities	
Chemical	**Threshold quantity (kg)**
Flammable Gases	Handling: 5,000 per day Storing: 200,000
Combustible Liquids	Handling: 5,000 per day Storing: 200,000
Methyl isocyanate	150
Phosgene	750
Acrylonitrile	20,000
Ammonia	200,000
Chlorine	20,000
Sulfur dioxide	250,000
Sulfur trioxide	75,000
Carbon disulfide	5,000
Hydrogen cyanide	1,000
Hydrogen fluoride	1,000
Hydrogen chloride	20,000
Hydrogen sulfide	1,000
Ammonium nitrate	500,000
Nitroglycerine	10,000
Trinitrotoluene	50,000
Hydrogen	50,000
Ethylene oxide	10,000
Phosphine	50
Silane	50

Annex IV: Consolidated List of Activities for Developing a Chemical Accidents Programme

Phase	Goals	Suggested Activities
Initial Phase: Commitments, Cooperation, and Consultations	• Put into place all the political and administrative prerequisites needed to develop, improve or review a chemical accidents programme. • Prepare a workplan for developing the programme.	• Secure the appropriate political commitment for this effort. • Identify key government authorities at national, regional, and local levels and establish a process for cooperation. • Organise consultations – within government and with other stakeholders – to raise awareness and undertake assessments of risks and needs. • Identify resources needed (people, funds, time) for each stage of the process of developing or reviewing a chemical accidents programme. • Develop a written statement of intent and workplan including a schedule and milestones.
Assessment Phase	To gain a general understanding of: • the nature and extent of the risks of chemical accidents in the country; • the existing legal and policy context in the country related to chemical safety; and • the resources that might be available to support a chemical accidents programme.	• Consult with stakeholders. • Consider the questions identified in this *Guidance*. • Identify sources of information available from within government agencies, local authorities, and other sources (including industry records). • Assign expert(s) to collect and review the information. • Establish criteria/models to determine which installations are of greatest concern. • Prepare a list of installations of concern and, if possible, identify the most important and map their location. • Survey mandates of relevant government bodies. • Survey existing programmes, laws, regulations, policies, international obligations, and other instruments. • Assess these to identify overlaps, gaps, inconsistencies, etc. • Identify resources that might be available (human, financial, technical, etc.) from within the country or from outside sources. • Develop a matrix, table, or database with this information.
Development Phase	• To develop a strategy and timetable for moving forward, based on a determination of priorities, resources, and the political, legal, and cultural context. • To implement the workplan and create an appropriate chemical accidents programme.	• Review the information gathered in the Assessment Phase. • Consult with key stakeholders. • Ensure continuing political commitment. • Review political imperatives, local considerations, and related activities in and outside government. • Develop a strategy for moving forward, identifying the steps to be taken, issues to be addressed, resource needs, milestones, and deadlines. • Review Chapter C to choose elements and adapt them for the country's particular circumstances. • Prepare a draft chemical accidents programme (for review by other agencies and stakeholder groups).
Implementation Phase: Resource Requirements	To identify, and then secure, the resources needed to effectively implement the chemical accidents programme. Resources include staff, budget, and equipment/ technology (information is addressed in the next step).	*Staff:* • identify the numbers and types of staff that is needed in light of roles identified in the chemical accidents programme, and the nature and extent of risks; • assign or hire staff (or, as necessary, use consultants) to meet these needs; and • establish and maintain an appropriate staff training programme. *Budget*: • prepare a realistic budget for carrying out assigned responsibilities; and • review options for securing the funds. *Technology, equipment, etc.* • identify the technology, equipment, and other resources needed (in addition to staff, financing, and information); and • determine where and how these resources can be accessed, as needed.

Consolidated List of Activities for Developing a Chemical Accidents Programme *(continued)*

Phase	Goals	Suggested Activities
Implementation Phase: Information Access and Sharing	To ensure the information needed for effective implementation of the chemical accidents programme is available and to develop mechanisms to share information with other stakeholders.	• Categorise the types of information needed for the chemical accidents programme. • Identify sources of information. • Systematically collect and record information. • Establish an inventory of hazardous installations. • Establish administrative structures, databases, and other mechanisms to facilitate the collection, review, maintenance, and updating of information from notifications and safety reports. • Establish an accidents reporting scheme. • Establish a mechanism for sharing information among the government bodies involved with the chemical accidents programme. • Create procedures for sharing information, and consultation, with all stakeholders including industry, workers, the public, and non-governmental organisations. • Ensure effective provision of information to the potentially affected public. • Establish mechanisms for the exchange of information within the country and between countries. • Promote exchange of experience and lessons learned.
Implementation Phase: Legal and Administrative Structures	To put into place the legal and administrative structures necessary to implement the chemical accidents programme.	• Consider which bodies are best placed to implement each element of the programme (it may be more than one). • Clarify how coordination will be maintained and who has the lead for each element.
Implementation Phase: Leadership	To improve public understanding of the risks of chemical accidents, to motivate industry and others to take appropriate actions to prevent such accidents, and to prepare adequately for any accidents that might occur.	• Establish an outreach programme to inform industry and others about chemical accident prevention and preparedness, as well as their roles and responsibilities under the chemical accidents programme. • Create mechanisms to facilitate improved accident prevention and preparedness including training programmes, guidance materials, websites, etc. • Develop a schedule for implementation by industry that allows industry an appropriate amount of time to comply with any requirements. • Ensure that the public has information about hazardous installations and what actions to take in the event of an accident. • Provide opportunities for public participation. • Maintain ongoing cooperation with stakeholders. • Promote sharing of experience.
Implementation Phase: Enforcement	To ensure that all enterprises meet legal requirements related to chemical accident prevention and preparedness, that they operate their installations to minimise risks of a chemical accident, and that they are adequately prepared should an accident occur.	• Identify appropriate sanctions for non-compliance with requirements (to the extent this is not already established in legal instruments). • Establish enforcement procedures and implement these procedures as appropriate (including prosecution for significant non-compliance). • Review safety reports and other submissions by hazardous installations for information about compliance, and to support inspection activities. • Establish procedures for undertaking inspections that are appropriate for the nature and extent of risks in the country. • Create common protocols and guidance to ensure the ability to compare different inspections. • Establish a strategy for maintaining inspector competency and learning from experience. • Establish mechanisms to ensure recommendations and remedial actions identified in inspection reports are carried out. • Coordinate and share experience among relevant organisations (to minimise duplicative efforts, reduce burden on industry, and learn from others' experience).

Consolidated List of Activities for Developing a Chemical Accidents Programme *(continued)*

Phase	Goals	Suggested Activities
Review and Revision Phase	To implement a system for the periodic review of the chemical accidents programme to test whether it is operating as intended and to revise the programme, as appropriate.	• Establish a process for reviewing the effectiveness of key elements of the chemical accidents programme (using performance indicators). • Consult with other stakeholders to get feedback on the chemical accidents programme. • Make changes to the programme's activities and priorities in light of experience, changes in priorities, technical progress, and other new information.

Annex V: Other International Initiatives

A number of international organisations – both intergovernmental and non-governmental – have significant projects designed to help others improve chemical accident prevention, preparedness and response.

This Annex describes several of them from:

- UNEP DTIE
- UNEP APELL Programme
- ILO
- UNECE
- UNEP/OCHA JEU
- UNIDO
- UNITAR
- WHO
- OECD
- EC – MAHB
- International Council of Chemical Associations' (representing the chemicals industry) Responsible Care framework

This Annex also includes additional information on international cooperation for accident prevention and preparedness.

UNEP Division of Technology, Industry and Economics

Throughout its history, the UNEP Division of Technology, Industry and Economics (DTIE) has worked with governments, business, industry, and civil society to protect the natural resource base of our planet, underlining the business case for sustainable development. DTIE's activities have traditionally focused on raising awareness, improving the transfer of knowledge and information, fostering technological cooperation and partnerships, and facilitating the implementation of international conventions and agreements.

The vision of DTIE is to decouple economic growth from environmental degradation by promoting environmentally sound technologies, new business concepts for industry, the mainstreaming of environment into economics, the creation of markets, and behavioural change. The DTIE strategy for achieving these goals is to promote informed decision-making through partnerships with other international organizations, governmental authorities, business and industry, and nongovernmental organizations; support implementation of conventions; and build capacity in developing countries.

DTIE's activities are oriented around three cross-cutting thematic priorities: climate change, resource efficiency, and harmful substances and hazardous wastes. Specific programmes within DTIE support authorities and industries in using natural resources efficiently, ensuring environmentally sound management of chemicals, reducing pollution and risks to people and the environment, enabling implementation of conventions and international agreements, and incorporating environmental costs into economic decisions. Projects aimed at improving chemical accident prevention, preparedness, and response include Responsible Production, which is aimed at engaging business and the supply-chain in safer production, risk communication, and emergency preparedness, and APELL, which is described below.

Awareness and Preparedness for Emergencies at Local Level

The Awareness and Preparedness for Emergencies at Local Level (APELL) programme was initially created in 1986 following a series of industrial accidents that occurred in both developed and developing countries and demonstrated the need for improved systems for preventing and responding to chemical emergencies. The APELL process was developed to assist communities with chemical hazards in preventing and preparing for industrial accidents. Since its inception, the programme has been used successfully in a number of diverse situations around the world.

The APELL process is a methodological tool focusing on the local level for identifying possible industrial hazards, raising safety awareness, and establishing local capacity for immediate, multi-party responses in the event that an emergency occurs. The goal of APELL is to promote a community-oriented framework to identify and create awareness of risks in industrialized communities, to initiate measures for risk reduction and

mitigation, and to develop coordinated preparedness between industries, local authorities, and communities, by building local partnerships between stakeholders. Because the risks, capabilities, stakeholders, and regulatory situation of a community will vary from place to place, the process was designed to be adaptable to local conditions.

APELL has now been promoted in over 40 countries, and key partnerships have been developed with government agencies and inter-governmental organisations responsible for industrial safety and protection of human health and the environment. A number of sector specific applications of APELL have been developed, including tools for transport and port areas. "APELL for Port Areas" was released in 1996, and "TransAPELL Guidance for Dangerous Goods Transport Emergency Planning in a Local Community" was published in 2000. Since 2001, closer cooperation with particular industry sectors has resulted in the development of specific guidelines and tools such as "APELL for Mining" released jointly with ICMM in 2001 and the "Good practice in emergency preparedness and response," a joint UNEP/ICMM publication of 2005.

Other UNEP publications related to APELL include the reports "Hazard Identification and Evaluation in a Local Community," "Storage of Hazardous Materials: A Technical Guide for Safe Warehousing of Hazardous Materials" and "Management of Industrial Accident Prevention and Preparedness: A Training Resource Package." A more recent publication, "Assessing the Vulnerabilities of Local Communities," was developed in partnership with the French *Institut National de l'Environnement Industriel et des Risques* (INERIS), and published by UNEP in 2008.

International Labour Organization

The International Labour Organization (ILO) addresses chemical safety as part of its mandate concerning worker protection. ILO Convention No. 174 (1993) on Prevention of Major Industrial Accidents forms the basis of ILO policies related to prevention of chemical accidents. ILO promotes efforts to improve chemical management through the following tools:

- Conventions and Recommendations
- Codes of Practice and Guidelines
- The global strategy on occupational safety and health
- Advisory services and training
- Guidelines on Occupational Safety and Health Management Systems (ILO-OSH 2001)
- The IPCS International Chemical Safety Cards Project
- The International Occupational Safety and Health Information Centre (CIS)

Additionally, the ILO Programme on Safety and Health at Work and the Environment (SAFEWORK) aims to create worldwide awareness of the dimensions and consequences of work-related accidents and diseases; to place occupational safety and health (OSH) on the international and national agendas; and to provide support to the national efforts for the improvement of national OSH systems and programmes in line with relevant international labour standards. Goals of the programme include the development of prevention policies and programmes to protect workers in hazardous occupations and sectors, extending protection to vulnerable groups of workers who fall outside the scope of traditional protective measures, and ensuring that the social and economic impacts of improving workers' protection are recognized by policy- and decision-makers. To achieve these goals, the programme promotes and implements ground-breaking research, statistical studies, and media-related activities and provides technical assistance to support national action.

UNECE – Convention on the Transboundary Effects of Industrial Accidents

The main objective of the UNECE Convention on the Transboundary Effects of Industrial Accidents is to improve industrial safety across the entire UNECE region, especially through the prevention of industrial accidents with transboundary consequences. The Conference of the Parties, governing body of the Convention, took note of the complexity of implementing some requirements of the Convention especially the ones requiring the coordinated involvement of a number of competent authorities at the national level. Certain tasks under the Convention also require vertical coordination between national, regional, and local authorities as well as industry and the public, taking into consideration transboundary cooperation. Some countries, especially from Eastern Europe, Caucasus and Central Asia (EECCA), and South-Eastern Europe (SEE), face difficulties in implementing the Convention.

This is the reason why the Conference of the Parties adopted an Assistance Programme in 2004 with the aim of enhancing the capacities of countries of EECCA and SEE to implement the Convention.

The Programme is based on the principle that assistance can be effective only if a recipient country is capable of receiving it and ready to take advantage of it. The Programme is therefore divided into two phases. In the first phase (preparatory phase) the objective is to ensure the commitment from countries participating to the Programme to implement the Convention and to verify that they have all the same basic level of implementation of the Convention.

The countries, having successfully finalised the preparatory phase, enter the second phase (implementation phase). In this phase, assistance is provided to help the countries solve problems encountered with complex tasks under the Convention. The organisation of the activities is done on a needs-driven basis where countries themselves identify the priority areas for the implementation of the Convention and, when needed, require external support.

To facilitate countries in this task, the Governing Body under the Convention has adopted a Strategic Approach, which outlines the mechanism for identifying shortcomings and gaps through indicators and criteria. This would also allow short- and long-term planning of activities and measuring the progress achieved. It also forms the basis for supporting adequate financial planning.

Past activities include:

- Training session on identification of hazardous activities according to Annex I under the Convention;
- Capacity building activity with an aim to initiate a process to further strengthen the legal and institutional frameworks for implementing the Convention in the countries of EECCA and SEE;
- Training session on Integrated Approaches to Major Hazard Prevention; and
- Project for Bulgaria, Romania, and Serbia on joint management of transboundary emergencies from spills of hazardous substance into the Danube River.

The Joint UNEP/OCHA Environment Unit

Following largely ad hoc and bilateral responses to industrial accidents, in 1993 the United Nations Member States requested a new mechanism to deal with the environmental aspects of disasters; hence the Joint UNEP/OCHA Environment Unit (JEU) was established to respond to environmental emergencies. Over the years the JEU has collaborated with governments, industries, and stakeholders to respond to emergencies such as chemical accidents as well as contribute to overall national preparedness efforts. The JEU works with affected countries to identify and mitigate acute negative impacts as well as foster technological cooperation and partnerships through its coordination of international response to environmental emergencies. It further collaborates with organisations dedicated to medium and long-term rehabilitation to ensure a seamless transition to the disaster recovery process.

JEU's activities are focused around two thematic areas, namely response and preparedness. In addition to response deployments, trainings are organized to enable national environmental experts to respond to international environmental emergencies. The latter programme area aims to improve response in countries particularly vulnerable to natural disasters. This is accomplished through preparedness workshops that develop capacity within national governments to respond to and prepare for events such as chemical accidents. The JEU works on emergency preparedness mainly through the APELL programme (initiated by UNEP), governments, and industry, with the purpose of minimising the occurrence and harmful effects of technological accidents and environmental emergencies.

A summary of response activities undertaken by the JEU over the past five years includes, among others, the explosion at a petrochemical plant in Jilin Province, China 2005; an oil spill caused by the Jiyeh power plant bombing in Lebanon 2006; toxic waste dumping in Cote d'Ivoire in 2006; a toxic spill of sodium cyanide from gold mining activities in Mongolia 2007; an oil spill in the Kerch Strait, Ukraine in 2007; an oil spill off the west coast of the Republic of North Korea in 2007; and explosion at an ammunition decommissioning facility in Tirana, Albania in 2008; and a toxic pesticide spill from a capsized ferry after Typhoon Fengshen in 2008. In each of these instances, the JEU liaised with the respective governments, and at times collaborated with the EC's Monitoring and Information Centre, UNEP's Post Conflict and Disaster Management Branch, and other stakeholders. Some of these accidents affecting hazardous installations had transboundary effects and cooperation with neighbouring countries was vital.

United Nations Industrial Development Organization

The United Nations Industrial Development Organization (UNIDO) is the specialized agency in the United Nations system that promotes industrial development for poverty reduction, inclusive globalization, and environmental stewardship. In response to today's most pressing environment and resource challenges, UNIDO

launched its organization-wide Green Industry initiative. The Green Industry agenda covers both the greening of industries – reducing waste, emissions, energy use, and materials consumption of any enterprise – as well as support for the development of green industries – the providers of environmental goods and services, such as recycling and renewable energy businesses.

A flagship UNIDO Green Industry programme involves the support to National Cleaner Production Centres (NCPCs), under the joint programme with UNEP on Resource Efficient and Cleaner Production in developing and transition countries. NCPCs provide national capacity for promotion, adaptation, and adoption of preventive environmental and productivity practices to contribute individually and synergistically to the three sustainability objectives of productive use of natural resources (including materials, energy, and water), reduction of waste and emissions, and safe and responsible production practices. Operational in over 45 countries, these NCPCs assist enterprises with the identification, evaluation, and implementation of practical cleaner production options, while also supporting governments to introduce supportive policy changes and enabling access to innovative environmentally sound technologies.

UNIDO implements complementary programmes related to chemicals, energy, and water. In the chemicals area, UNIDO supports the implementation of multilateral agreements, including the Stockholm Convention, the Montreal Protocol, and the Strategic Approach to International Chemicals Management. Activities target improvement of the management systems and policy regimes, dissemination of best available techniques, and transfer of substitute clean technologies and process chemistries. UNIDO's energy portfolio concerns energy efficiency and renewable energy, as these apply to the productive sectors, through both cross-sector activities, including promotion of energy management system standards and system optimization, as well as sector and/or technology specific activities. In the water area, UNIDO is active in promoting ecosystem-based management practices for (international) waters, including pollution load reduction from land based sources, such as industries and coastal tourism.

United Nations Institute for Training and Research

The United Nations Institute for Training and Research (UNITAR) Training and Capacity Building Programme in Chemicals and Waste Management emphasizes cooperation among national stakeholders and international partner organizations in order to foster an integrated approach to chemicals management and capacity building. Part of this effort includes the National Profile Support Programme, which provides assistance to countries in assessing and diagnosing the existing infrastructure for the sound management of chemicals as an important step towards building national capacity in a systematic way.

The National Profile Support Programme provides guidance, training, and technical support to assist countries in assessing their relevant legal, institutional, administrative, and technical infrastructures. This information is used to develop National Chemicals Management Profiles and implement National Action Programmes for Integrated Chemicals Management. The development of a National Chemicals Management Profile has been recognized in the outcomes of the International Conference on Chemicals Management (ICCM) as a key enabling activity to support SAICM implementation. By January 2010, some 140 countries have prepared, or are preparing, a National Profile following the UNITAR National Profile Guidance Document. At the international level, National Profiles provide others with a better understanding of the existing capabilities of countries, as well as their needs. Although the National Profiles address a broad subject area and can assist with identifying national priorities, they can also provide important insights during the development and implementation of a chemical accidents programme. Additionally, a new chapter on "Chemical Emergency Preparedness, Response, and Follow-up" is being prepared for inclusion in a revised Guidance Document.

World Health Organization

The World Health Organization's (WHO) work in chemical safety is largely undertaken by the Department of Public Health and Environment (PHE) at WHO headquarters. Areas of activity include evaluations of chemical risks to human health and the environment, methodologies for risk assessment, capacity building for sound management of chemicals and risk reduction, poisons centre development, and chemical incidents and emergencies.

The Chemical Team within PHE routinely reviews global health intelligence for chemical events of public health concern, assesses and verifies detected events and alerts partners to take timely action. Upon the request of WHO Member States, the Chemical Team also provides and coordinates chemical incident response functions. Other activities by the Chemical Team aim at strengthening national capacities for the public health management of chemical incidents and emergencies, particularly in developing countries and countries with economies in transition, as well as the development of global expert networks, including ChemiNet a network of health experts for chemical emergency response.

Organisation for Economic Co-operation and Development

The OECD Chemicals Programme was established in 1978. Its main objectives are to: assist OECD member countries' efforts to protect human health and the environment through improving chemical safety; make chemical control policies more transparent and efficient to save resources for governments and industry; and prevent unnecessary distortions in the trade of chemicals and chemical products. While an important focus of the work is on the production, processing, and use of industrial chemicals, some aspects include work on pesticides, chemical accidents, and biotechnology.

The OECD Programme on Chemical Accidents helps public authorities, industry, labour, and other interested parties prevent and/or prepare for accidents involving chemicals, and respond appropriately to those that occur. The Chemical Accidents Programme works in three areas, in cooperation with other international organisations:

- developing common principles and policy guidance on prevention of, preparedness for, and response to chemical accidents;
- analysing issues of concern and making recommendations concerning best practices; and
- facilitating the sharing of information and experience between both OECD and non-member countries.

The Chemical Accidents Programme has developed the OECD *Guiding Principles for Chemical Accident Prevention, Preparedness and Response* (2nd ed., 2003), which addresses all aspects of preventing and managing chemical accidents, and the OECD *Guidance on Developing Safety Performance Indicators* (2nd ed., 2008), which serves as a guide for key stakeholders to determine if their implementation of the *Guiding Principles* has led to improved chemical safety.

The Chemical Accidents Programme organises workshops on specific issues to gather information and make recommendations concerning best practices. Examples of subjects include: accident investigation; health and environmental aspects of chemical accidents; audits and inspections of hazardous installations; training of engineers in risk management; use of safety reports in the control of major accident hazards; lessons learned from accidents; integrated management of safety, health, environment, and quality; risk assessment practices for hazardous substances involved in accidental releases; human factors in chemical accidents and incidents; and safety in marshalling yards.

The Chemical Accidents Programme helps countries share information and learn from each other's experience in: the development of databases; exchange of information in areas of chemical safety, risk assessment, risk management, and risk communication; sharing of experience with respect to relevant technologies, practices, and policies for chemical accident prevention, preparedness, and response; creation of discussion groups/ electronic forums on specific subjects; and collection and analysis of data on chemical accidents, including economic data.

European Commission – Major Accidents Hazards Bureau

The European Commission – Joint Research Centre – Major Accident Hazards Bureau (MAHB) gives scientific and technical support to the Directorate of the General Environment for the implementation and monitoring of the Seveso II Directive. As part of its activities, the MAHB manages the Major Accident Reporting System (MARS), which was established to handle the information on major accidents submitted by Member States of the European Union to the European Commission in accordance with the provisions of the Seveso II Directive. Currently, MARS holds information on over 450 major accidents. Users can search the MARS database for information on the type of accident, the industry, and activity involved, immediate and underlying causes, consequences and emergency measures taken, and lessons learned. The information is also used to perform lessons learned type of data analyses, identifying significant dependencies and overall patterns in the data.

The MAHB also manages the Community Documentation Centre on Industrial Risk (CDCIR) whose objective is to create a bibliographic and scientific environment which facilitates exchange of information between the Member States on the control of major hazard industrial activities, and to gain maximum knowledge from the common European effort towards industrial safety. The CDCIR contains more than 3,000 carefully reviewed and abstracted public documents, issued by governmental institutions, industry, and research institutes. Users can search the CDCIR for information on a particular aspect of industrial risk, and MAHB also prepares a regular bulletin with details and summaries of acquired material.

Finally, the MAHB also includes Technical Working Groups who produce guidance on various aspects of implementation of the Seveso II Directive. These groups have been set up to provide a forum for discussion and comparison of national approaches to various aspects of the Seveso Directives. In most cases, the groups include representatives from the National Authorities and interested parties, such as chemical or petrochemical industry groups or organizations specifically concerned with safety or environmental issues. Currently, Working

Groups exist on inspection systems, safety management systems, land-use planning, substances dangerous for the environment, and other issues related to industrial risk. The guidance documents on Safety Reports and Safety Management Systems (outcomes of corresponding Working Groups) are available on the MAHB's website.

Chemical Industry's Responsible Care

An example of a voluntary initiative is the chemical industry's Responsible Care framework. Initiated in Canada in 1985, Responsible Care is a voluntary commitment of the chemical industry to go beyond legal requirements. Under this framework, companies work together through their national associations in a continuous search to improve their health, safety, and environmental performance, promoting communication with their stakeholders about products and processes.

With a focus on meeting and going beyond legislative and regulatory compliance, the Responsible Care framework comprises the specific commitment to continuous improvement in health, safety, and environmental performance, and to openness and transparency with stakeholders. It helps companies improve performance by identifying and spreading good management practices, and promotes mutual support between companies and associations through experience sharing and peer pressure.

Responsible Care encourages dialogue and cooperation with stakeholders at the local, national, and international level, and has helped industry work much more closely with local communities, governments, trades unions, international organisations, environmental groups, and others to understand and address their concerns. Responsible Care also promotes cooperation with governments and organisations in the development and implementation of effective regulations and standards, and helps companies at all stages of the product chain meet or exceed these requirements.

The original Responsible Care framework included six Codes of Practice:

i. Process Safety
ii. Employee Health and Safety
iii. Pollution Prevention
iv. Emergency Response
v. Distribution
vi. Product Stewardship

The new Responsible Care Global Charter (RCGC) was launched by the International Council of Chemical Associations (ICCA) at UNEP's International Conference on Chemicals Management in Dubai in February 2006, alongside with the new Global Product Strategy (GPS) initiative.

The Responsible Care Global Charter extends the original elements of Responsible Care, focusing on new and important challenges facing the chemical industry and society including sustainable development, the effective management of chemicals along the value chain, public health issues related to the use of chemical products, the need for greater industry transparency, and the opportunity to achieve greater harmonisation and consistency among Responsible Care programmes around the world.

The new Global Product Strategy (GPS) initiative is focused on product stewardship and in the extension of Responsible Care along the value chain. In 2007, ICCA launched its Product Stewardship Guidelines to assist companies in designing and implementing product stewardship programmes through a management systems approach.

International Cooperation

Cross-Boundary Cooperation: Neighbouring countries should exchange information, and consult each other, with the objective of preventing accidents capable of causing transboundary damage and reducing adverse effects should such an accident occur.[41]

To this end, a country where a hazardous installation is located or planned ("host country") should provide to all potentially affected countries relevant information concerning existing or planned hazardous installations. The potentially affected countries should provide the host country relevant information concerning the area under its jurisdiction that could be affected by transboundary damage in the event of an accident.

For cases where an accident at a hazardous installation may have transboundary effects, emergency planning and response should be carried out in cooperation with neighbouring countries. The countries should consult one another with a view to coordinating off-site emergency planning. They should inform each other of the communications systems to be used, the main features of their emergency plans, and the means available for emergency response in the event of an accident. Mechanisms should be in place to ensure that information is provided to all stakeholders on both sides of the border potentially affected in the event of an accident.

Neighbouring governments should establish mechanisms to facilitate pooling and/or sharing response (including medical) resources in the event of an accident which is too big to be handled by the host country alone.

Procedures should be developed to facilitate the transit through their territory of personnel and equipment to be used for mutual aid in the event of an accident involving hazardous substances.

Participation in International Activities: The government, industry, and other stakeholders should be involved in appropriate multinational and regional cooperative activities related to accident prevention and/or emergency planning in order to share experience, improve planning, and facilitate appropriate coordination of emergency response in the event of an accident.

Intergovernmental organisations have an important role to play in influencing and assisting in the implementation of sound chemical safety practices, and in encouraging the use of, and facilitating access to, information and guidance to help in this process. In particular, intergovernmental organisations can serve as a link between countries to share lessons learned, and to ensure that countries are able to take appropriate advantage of the many technical resources and expertise that exists in the area of chemical safety.

In particular, intergovernmental organisations can:

- provide a forum for exchange of information and experience;
- facilitate collaboration, assistance, financial support, and access to information and technical expertise;
- broker information and assistance between donors and recipients;
- support capacity-building projects (at local and regional levels);
- encourage and support the further development of procedures and tools for implementing relevant guidance;
- coordinate multilateral assistance to ensure that needs are met and that duplication is avoided;
- raise awareness concerning the importance of instituting appropriate programmes;
- support adaptation of programmes and tools for use in developing countries;
- mobilise and coordinate international assistance for those facing emergencies, particularly when domestic capacity is exceeded and/or neutral and independent assessments are required;
- undertake or sponsor global reviews of safety performance;
- promote appropriate stakeholder involvement in prevention, preparedness, and response initiatives;
- facilitate technology transfer to those in greatest need (between developed and developing countries); and
- provide a practical link with industry and professional organisations to promote greater use of international guidance materials and health, safety, and environment systems by industry, and to facilitate the international standardisation of reporting and management systems and tools.

[41]See *e.g.*, the UNECE Conventions on Transboundary Effects of Industrial Accidents and on the Protection and Use of Transboundary Watercourses and International Lakes.

Annex VI: Selected Bibliography

This bibliography is set out in four parts as follows:

a. Publications
- (i) General
- (ii) Topics
  - a. Community Awareness/Information to the Public
  - b. Emergency Preparedness
  - c. Emergency Response
  - d. General Duty Clause
  - e. Hazard and Risk Assessment
  - f. Health Aspects
  - g. Information on Chemicals
  - h. Inherent Safety
  - i. Inspections
  - j. Land-Use Planning
  - k. List of Chemicals/Scope
  - l. Mining
  - m. Pipelines
  - n. Review and Assessment
  - o. Safety Management Systems
  - p. Safety Reporting
  - q. Site Security
  - r. Storage of Hazardous Substances
  - s. Transport of Hazardous Substances (including Port Areas)

b. Legal Instruments

c. Accident Reports and Case Studies

d. Organisations and Their Websites

a. Publications

(i) General

ILO, *Preventing Major Industrial Accidents in Asia: A Guide* (Bangkok, 2000):
http://www.ilo.org/public/english/region/asro/bangkok/asiaosh/ilorepor/prevt/indexpv.htm

ILO, *Prevention of Major Accident Hazards* (Geneva, 1991):
http://www.ilo.org/safework/normative/codes/lang--en/docName--WCMS_107829/index.htm

ILO, *Major Hazard Control: A Practical Manual* (Geneva, 1988), ISBN: 9221064328

OECD, *Guiding Principles for Chemical Accident Prevention Preparedness and Response* (Paris, 2nd ed., 2003):
www.oecd.org/ehs

Swedish Rescue Services Agency (SRSA), *Proactive Risk Management in a Dynamic Society* (Räddningsverket, 2000), ISBN: 91-7253-084-7:
http://www2.msb.se/Shopping/pdf/16252.pdf

UNEP, *APELL Handbook* (Paris, 1988), ISBN: 92 807 1183 0:
http://www.unep.fr/scp/publications/details.asp?id=WEB/0064/PA

UNEP, *Management of Industrial Accident Prevention and Preparedness: A Training Resource Package* (Paris, 1996), ISBN: 92-807-1609-3:
http://www.unep.fr/scp/publications/details.asp?id=WEB/0110/PA

US EPA, *Chemicals in Your Community* (1999):
http://www.epa.gov/emergencies/docs/chem/chem-in-comm.pdf

(ii) Topics

a. Community Awareness/Information to the Public

MAHB, *General Guideline on the Content of Information to the Public* (Luxembourg,1994), ISBN: 92-826-9053-9:
http://mahbsrv.jrc.it/downloads-pdf/EN-info.pdf

b. Emergency Preparedness

JEU, *Guidelines for the Development of a National Environmental Contingency Plan:*
http://ochaonline.un.org/OchaLinkClick.aspx?link=ocha&DocId=1005356

WHO, *Manual for the Public Health Management of Chemical Incidents* (Geneva, 2009), ISBN: 978 92 4 159814 9:
http://www.who.int/environmental_health_emergencies/publications/Manual_Chemical_Incidents/en/index.html

c. Emergency Response

ChemTrec: provides assistance to emergency responders responsible for incidents involving hazardous materials and dangerous goods:
www.chemtrec.com

JEU, *Guidelines for Environmental Assessment following Chemical Emergencies*:
http://ochaonline.un.org/OchaLinkClick.aspx?link=ocha&DocId=1001277

JEU, *Guidelines for Environmental Emergencies: Version 1* (New York and Geneva, 2009):
http://ochaonline.un.org/OchaLinkClick.aspx?link=ocha&docId=1135171

Swedish Civil Contingencies Agency: Training for emergency response (including addressing emergencies involving hazardous substances):
http://www.msb.se/en/Training--Exercises/Courses/

Swedish Civil Contingencies Agency Webpage: Includes information on hazardous substances and emergency preparedness:
http://www.msb.se/en/Civil-contingencies/

d. General Duty Clause

Van Gils, Erik and Hailwood, Mark, *How to move closer towards a harmonized understanding of Seveso II requirements?* (2008):[42]
http://mahbsrv.jrc.it/downloads-pdf/Document%2020-3-5%20Magic%20Words%20_3.pdf

US EPA, *Guidance for the Implementation of the General Duty Clause Section 112(r)(1)* (2008):
http://www.pneac.org/compliance/EPA/guidancegendutycaa.pdf

US EPA, *Fact Sheet on the General Duty Clause (2009)*:
http://epa.gov/emergencies/docs/chem/gdc-fact.pdf

e. Hazard and Risk Assessment

European Process Safety Centre (EPSC), Brian J. Tyler, Frank Crawley, and Malcolm L. Preston, ed., *HAZOP: Guide to Best Practice* (2nd ed., 2008), ISBN: 9780852955253

Lewis, Richard J., *Sax's Dangerous Properties of Industrial Materials* (10th ed.) and *Hawley's Condensed Chemical Dictionary* (13th ed.) CD-ROM Network 6-10 (2000) Software, ISBN: 978-0-471-37998-0

[42]At the time of writing, the EC MAHB was in the process of updating their website and some internet addresses in this document may change. After the website is fully updated, all documents referenced herein will be available at: http://mahb.jrc.ec.europa.eu.

Mannan, Sam, ed., *Lees' Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control*, Mary Kay O'Connor Process Safety Center, Department of Chemical Engineering, Texas A&M University (College Station, Texas, 2004), ISBN-13: 978-0-7506-7555-0; ISBN-10: 0-7506-7555

UNEP and INERIS, *Assessing the Vulnerability of Local Communities* (Paris, 2008): http://www.unep.org/publications/search/pub_details_s.asp?ID=4095

UNEP, *Hazard Identification and Evaluation in a Local Community* (Paris, 1992), ISBN: 92-807-1331-0: http://www.unep.fr/scp/publications/details.asp?id=WEB/0062/PA

Urben, Peter, ed., *Bretherick's Handbook of Reactive Chemical Hazards, Volumes 1-2* (7th ed., Swizerland, 2006), ISBN-13: 978-0-12-372563-9; ISBN-10: 0-12-372563-1

f. Health Aspects

IPCS, OECD, UNEP, and WHO, *Health Aspects of Chemical Accidents: Guidance on Chemical Accident Awareness, Preparedness and Response for Health Professionals and Emergency Responders*, Environmental Monograph No. 81 (Paris, 1994): http://helid.desastres.net/en/d/Js13456e/

WHO, *Assessing the Health Consequences of Major Chemical Incidents: Epidemiological Approaches*, Regional Publications, European Series No. 79 (1997) ISBN: 92 890 1343 5: http://apps.who.int/bookorders/anglais/detart1.jsp?sesslan=1&codlan=1&codcol=31&codcch=79

WHO, *Effective Media Communication during Public Health Emergencies* (Handbook, Field Guide, and Wall chart), (2005): http://www.who.int/csr/resources/publications/WHO_CDS_2005_31/en/index.html

WHO, *Environmental Health in Emergencies and Disasters: A Practical Guide* (Geneva, 2002), ISBN: 92 4 154541 0: http://www.who.int/water_sanitation_health/emergencies/emergencies2002/en/index.html

WHO, *Human Risk Assessment Toolkit for Chemicals* (2010 – in preparation): http://www.who.int/ipcs/methods/harmonization/areas/ra_toolkit/en/index.html

WHO, *International Health Regulations* (Geneva, 2nd ed., 2005), ISBN: 978 92 4 158041 0: http://www.who.int/ihr/en/

WHO, *Manual for the Public Health Management of Chemical Incidents* (Geneva, 2009), ISBN: 978 92 4 159814 9: http://www.who.int/environmental_health_emergencies/publications/Manual_Chemical_Incidents/en/index.html

g. Information on Chemicals

International Programme on Chemical Safety, *INCHEM: Chemical Safety Information from Intergovernmental Organizations*: www.inchem.org

JRC, Classification and Labelling Database under Directive 67/548/EEC (multi-lingual): http://ecb.jrc.ec.europa.eu/classification-labelling/

OECD, eChemPortal: http://webnet3.oecd.org/echemportal

UNECE, Globally Harmonized System of Classification and Labelling of Chemicals (GHS): http://www.unece.org/trans/danger/publi/ghs/ghs_welcome_e.html

h. Inherent Safety

Crowl, Daniel, ed., *Inherently Safer Chemical Processes* (New York, 1997), pp. 39-40, ISBN-13: 978-0816907038

Hendershot, Dennis C., "Conflicts and decisions in the search for inherently safer process options," *Process Safety Progress* (1995), Vol. 14, Issue 1, pp. 52-56

Hendershot, Dennis C., "Inherently safer chemical process design," *Journal of Loss Prevention* (1997), Vol. 10, Issue 3, pp. 151-157

Kletz, Trevor A., "Inherently Safer Design: The growth of an idea," *Process Safety Progress* (1996), Vol. 15, Issue 1, pp. 5-8

Kletz, Trevor A., *Process Plants: A Handbook for Inherently Safer Design* (Philadelphia, 1998), p. 193, ISBN: 1560326190

Kletz, Trevor A., "What You Don't Have, Can't Leak," *Chemistry and Industry* (1978), Vol. 6, pp. 287-292

Ashford, N.A. and Zwetsloot, G., "Encouraging Inherently Safer Production in European Firms: a Report from the Field," *Journal of Hazardous Materials* (1999) Vol.78, Issues 1-3, pp. 123-144: http://mahbsrv.jrc.it/Proceedings/Greece-Nov-1999/E1-ASHFORD-z.pdf

Mannan, M.S., Hendershot, D. and Kletz, T.A., "Fundamentals of Process Safety and Risk Management," *Encyclopedia of Chemical Processing and Design* (New York, 2002), Vol. 69, Supplement 1, pp. 49-94

i. Inspections

MAHB, *Guidance on Inspections as Required by Article 18 of the Council Directive 96/82/EC (Seveso II)* (1999):
http://mahb.jrc.ec.europa.eu/index.php?id=55

j. Land-Use Planning

MAHB, *Land Use Planning Guidelines in the Context of Article 12 of the Seveso II Directive 96/82/EC* as *Amended by Directive 105/2003/EC* (2006):
http://mahb.jrc.ec.europa.eu/index.php?id=55

k. List of Chemicals/Scope

Maria Smeder, MAHB, *Seveso Directive Annex III Substances in the Seveso II Directive* (Italy):
http://mahbsrv.jrc.it/downloads-pdf/Seveso2-Annex3.pdf

Maria Smeder, MAHB, *Substances covered by Part 1, Annex I, of the Seveso II Directive* (Italy):
http://mahbsrv.jrc.it/downloads-pdf/Seveso2-Annex1.pdf

US EPA, *Accidental Release Prevention Requirements: Risk Management Programs Under the Clean Air Act, Section 112(r)(7); List of Regulated Substances and Thresholds for Accidental Release Prevention, Stay of Effectiveness; and Accidental Release Prevention Requirements: Risk Management Programs Under Section 112(r)(7) of the Clean Air Act as Amended*, Guidelines; Final Rules and Notice. 61 FR 31667 (June 20, 1996):
http://www.epa.gov/fedrgstr/EPA-AIR/1996/June/Day-20/pr-23439.pdf

l. Mining

UNEP and the International Council on Mining and Metals (ICMM), *APELL for Mining* (Paris, 2001):
http://www.unep.fr/scp/sp/publications/

UNEP and ICMM, *Good Practice in Emergency Preparedness and Response* (United Kingdom, 2005):
http://www.icmm.com/document/8

m. Pipelines

UNECE Joint Expert Group on Water and Industrial Accidents, *Prevention of Accidental Water Pollution, Safety Guidelines and Good Practices for Pipelines* (2006):
http://www.unece.org/env/documents/2006/teia/ECE_CP.TEIA_2006_11%20E.pdf

n. Review and Assessment

The Centre for Chemical Process Safety (CCPS), *Process Safety Leading and Lagging Metrics – You Don't Improve What You Don't Measure* (New York, 2008):
http://www.aiche.org/uploadedFiles/CCPS/Metrics/CCPS_metrics%205.16.08.pdf

OECD, *Guidance on Developing Safety Performance Indicators for Industry* (Paris, 2nd ed., 2008):
http://www.oecd.org/dataoecd/6/57/41269710.pdf

OECD, *Guidance on Developing Safety Performance Indicators for Public Authorities and Communities/ Public* (Paris, 2nd ed., 2008):
http://www.oecd.org/dataoecd/7/15/41269639.pdf

United Kingdom Health and Safety Executive and Chemical Industries Association, *Developing Process Safety Indicators: A step-by-step guide for chemical and major hazard industries* (2006), ISBN: 0717661806:
http://www.hse.gov.uk/pubns/priced/hsg254.pdf

o. Safety Management Systems

ILO, *Guidelines on Occupational Safety and Health Management Systems ILO – OSH 2001* (Geneva, 2001), ISBN: 92-2-111634-4:
http://www.ilo.org/safework/normative/codes/lang--en/docName--WCMS_107727/index.htm

MAHB, *Guidelines on a Major Accident Prevention Policy and Safety Management System, as Required by Council Directive 96/82/EC (Seveso II)*, ISBN: 92-828-4664-4:
http://mahb.jrc.ec.europa.eu/index.php?id=55

p. Safety Reports

MAHB, *Guidance on the Preparation of a Safety Report to Meet the Requirements of Council Directive 96/82/EC (Seveso II)* (Luxembourg, 1997), ISBN: 92-828-1451-3:
http://mahb.jrc.ec.europa.eu/index.php?id=55

United Kingdom Health and Safety Executive, *COMAH Guidance (Safety report assessment manual, safety report assessment guides, and technical aspects):*
http://www.hse.gov.uk/comah/guidance.htm

US EPA, *Guidance for Auditing Risk Management Plans/Programs under Clean Air Act Section 112(r)* (1999):
http://www.epa.gov/emergencies/docs/chem/audit_gd.pdf

q. Site Security

American Chemistry Council, *Responsible Care Security Code of Management Practices*:
http://www.americanchemistry.com/s_responsiblecare/doc.asp?CID=1298&DID=5085

CCPS, *Security and Vulnerability Analysis* (SVA) website:
http://www.aiche.org/ccps/knowledgebase/securityvul.aspx

r. Storage of Hazardous Substances

UNEP, *Storage of Hazardous Materials: A Technical Guide for Safe Warehousing of Hazardous Materials* (Paris, 1990), ISBN: 928071239X:
http://www.unep.org/publications/search/pub_details_s.asp?ID=1083

s. Transport of Hazardous Substances (including Port Areas)

Intergovernmental Organisation for International Carriage by Rail, *Convention concerning International Carriage by Rail (COTIF);* Appendix C: Regulation concerning the International Carriage of Dangerous Goods by Rail (RID) (1999):
http://www.otif.org/en/publications.html

International Air Transport Association (IATA), *Dangerous Good Regulations (DGR)* (2010 ed.):
http://www.iata.org/ps/publications/dgr/

International Civil Aviation Organization (ICAO), *Technical Instructions for the Safe Transport of Dangerous Goods by Air* (2009-2010 ed.):
http://www.icao.int/anb/fls/dangerousgoods/TechnicalInstructions/

International Maritime Organisation, *International Maritime Dangerous Goods (IMDG) Code*:
http://www.imo.org/safety/mainframe.asp?topic_id=158

OECD, *Safety in Tunnels – Transport of Dangerous Goods through Road Tunnels* (2001), ISBN: 9789264196513:
http://www.oecdbookshop.org/oecd/display.asp?K=5LMQCR2KC17F&DS=Safety-in-Tunnels

Switzerland Federal Office of the Environment, Forests and Landscape, *Risk Evaluation Criteria for Transport Routes* (2001):
http://www.bafu.admin.ch/publikationen/publikation/00553/index.html?lang=fr
(in French; also available in Italian and German)

United Kingdom Health and Safety Executive, *Carriage of Dangerous Goods Manual (guidance on ADR)*:
http://www.hse.gov.uk/cdg/manual/index.htm

United Kingdom Department for Transport, *Carriage of Dangerous Goods Website (guidance on ADR, RID, IMDG, and ICAO TI)*:
http://www.dft.gov.uk/pgr/freight/dgt1/

UNECE, *Dangerous goods home page*:[43]
http://www.unece.org/trans/danger/danger.htm

UNECE, *Dangerous goods publications*:
http://www.unece.org/trans/danger/publi/dg_publications.html

UNECE, *European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)* (2009):
http://www.unece.org/trans/danger/publi/adr/adr_e.html

UNECE Inland Transport Committee, *Industry Guidelines for the Security of the Transport of Dangerous Goods by Road* (2005):
http://www.unece.org/trans/doc/2005/wp15/TRANS-WP15-78-inf10e.pdf

UN, *UN Recommendations on the Transport of Dangerous Goods – Model Regulations* (16th ed., 2009):
http://www.unece.org/trans/danger/publi/unrec/rev13/13nature_e.html

UNEP, *APELL for Port Areas: Preparedness and Response to Chemical Accidents in Ports* (Paris, 1996):
http://www.unep.fr/scp/sp/publications/

UNEP, *TransAPELL: Guidance for Dangerous Goods Transport: Emergency Planning in a Local Community* (Paris, 2000), ISBN: 92 807 1907 6:
http://www.unep.fr/scp/sp/publications/

[43]The UNECE Dangerous Goods homepage provides an overview of regulations regarding dangerous goods transport as well as activities and guidance. Links to specific regulatory and guidance documents are also provided for users searching for specific documentation.

b. Legal Instruments

ILO:
http://www.ilo.org/ilolex/english/convdisp1.htm

- Convention No. 187 concerning the Promotional Framework for Occupational Safety and Health (2006)
- Convention No. 174 concerning the Prevention of Major Industrial Accidents (1993)
- Recommendation No.181 concerning the Prevention of Major Industrial Accidents (1993)
- Convention No. 170 concerning Safety in the use of Chemicals at Work (1990)
- Convention No. 155 concerning Occupational Safety and Health and the Working Environment (1981)

UNEP:
http://www.unep.org/DEC/Links/Chemicalsandwastes.asp

- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal
- Stockholm Convention on Persistent Organic Pollutants
- Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (joint interim secretariat with FAO)

UNECE:
http://www.unece.org/env/teia/welcome.html

- Convention on Transboundary Effects of Industrial Accidents (1992)

WHO:
http://www.who.int/ihr/en/

- International Health Regulations 2005 (IHR 2005)

European Union:
http://ec.europa.eu/environment/seveso/legislation.htm

- Council Directive 96/82/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances, amended by the Directive 2003/105/EC of the European Parliament and of the Council of 16 December 2003.

United States:
http://www.epa.gov/emergencies/lawsregs.htm

- Risk Management Program (RMP): Section 112(r) of the amended Clean Air Act, with its regulations (40 CFR Part 68); and
- Emergency Planning & Community Right-to-Know (EPCRA): 42 U.S.C. 116, with its regulations (*e.g.*, 40 CFR 355, 40 CFR 370).

c. Accident Reports and Case Studies

CCPS, *Process Safety Beacon archive*:
www.sache.org

French Ministry of Ecology and Sustainable Development, *Aria Database of industrial accident reports*:
http://www.aria.developpement-durable.gouv.fr/ (available in French and English)

IchemE, *Loss Prevention Bulletin*:
http://www.icheme.org/lpb

IchemE, *United Kingdom Health and Safety Executive accident reports*:
http://cms.icheme.org/mainwebsite/general-bara492fef27d8d4c3d56cb34e1.aspx?map=38404a6726fb2f4baeec91a305f73c39 (out of print accident reports available for download)

Kletz, Trevor, *Still Going Wrong! Case Histories of Process Plant Disasters and How They Could Have Been Avoided* (1st ed., 2003), ISBN: 0750677090

Kletz, Trevor, *What Went Wrong?: Case Histories of Process Plant Disasters* (4th ed., 1998), ISBN: 0884159205

Sanders, Roy E., *Chemical Process Safety – Learning from Case Histories* (3rd ed., 2005):
http://knovel.com/web/portal/browse/display?_EXT_KNOVEL_DISPLAY_bookid=1881&VerticalID=0

UK Health and Safety Executive, *Control of Major Accident Hazards (COMAH) accident reports*:
http://www.hse.gov.uk/comah/accidents.htm

United States Chemical Safety Board (CSB), *Completed investigations*:
http://www.csb.gov/investigations/investigations.aspx?Type=2&F_All=y

d. Organisations and their Websites

CCPS:
Center for Chemical Process Safety (American Institute of Chemical Engineers)
(www.aiche.org/ccps)

EC:
European Commission
(http://ec.europa.eu) (http://ec.europa.eu/environment/seveso)

IChemE:
Institution of Chemical Engineers
(http://www.icheme.org/safety)

ILO:
International Labour Organization
(www.ilo.org/public/english/protection/safework/index.htm)

IOMC:
Inter-Organization Programme for the Sound Management of Chemicals
(www.who.int/iomc)

IPCS:
International Programme on Chemical Safety
(http://www.who.int/ipcs/emergencies/en/)

JEU:
Joint UNEP/OCHA Environment Unit
(http://ochaonline.un.org/ochaunep)

JRC:
Joint Research Centre:
(www.jrc.ec.europa.eu)

MAHB:
Major Accident Hazards Bureau
(http://mahb.jrc.ec.europa.eu)

MSB:
Swedish Civil Contingencies Agency
(http://www.msb.se/en/)

OCHA:
United Nations Office for the Coordination of Humanitarian Affairs
(http://ochaonline.un.org)

OECD:
Organisation for Economic Co-operation and Development
(www.oecd.org/ehs)

UNECE:
UN Economic Commission for Europe, Convention on the Transsboundary Effects of Industrial Accidents
(www.unece.org/env/teia)

UNEP DTIE:
UNEP Division of Technology, Industry and Economics
(www.unep.fr)

UNEP Safer Production
Including Awareness and Preparedness for Emergencies at Local Level (APELL)
(www.unep.fr/scp/sp)

UNIDO:
United Nations Industrial Development Organization
(www.unido.org)

USCSB:
US Chemical Safety and Hazard Investigation Board
(www.chemsafety.gov)

US EPA:
US Environmental Protection Agency
(www.epa.gov/emergencies)

WHO:
World Health Organization
(www.who.int/environmental_health_emergencies/en/index.html)

About the UNEP Division of Technology, Industry and Economics

The UNEP Division of Technology, Industry and Economics (DTIE) helps governments, local authorities and decision-makers in business and industry to develop and implement policies and practices focusing on sustainable development.

The Division works to promote:

> sustainable consumption and production,
> the efficient use of renewable energy,
> adequate management of chemicals,
> the integration of environmental costs in development policies.

The Office of the Director, located in Paris, coordinates activities through:

- **The International Environmental Technology Centre** – IETC (Osaka, Shiga), which implements integrated waste, water and disaster management programmes, focusing in particular on Asia.
- **Sustainable Consumption and Production** (Paris), which promotes sustainable consumption and production patterns as a contribution to human development through global markets.
- **Chemicals** (Geneva), which catalyzes global actions to bring about the sound management of chemicals and the improvement of chemical safety worldwide.
- **Energy** (Paris and Nairobi), which fosters energy and transport policies for sustainable development and encourages investment in renewable energy and energy efficiency.
- **OzonAction** (Paris), which supports the phase-out of ozone depleting substances in developing countries and countries with economies in transition to ensure implementation of the Montreal Protocol.
- **Economics and Trade** (Geneva), which helps countries to integrate environmental considerations into economic and trade policies, and works with the finance sector to incorporate sustainable development policies.

UNEP DTIE activities focus on raising awareness, improving the transfer of knowledge and information, fostering technological cooperation and partnerships, and implementing international conventions and agreements.

For more information,
see **www.unep.fr**

Industrial accidents involving chemicals – such as spills, explosions, fires, or vapour clouds – can injure or kill people and cause significant damage to property, the environment, and the local economy.

An effective chemical accidents programme will help avoid accidents and minimise adverse impacts should they occur. The prevention of chemical accidents and proactive management of chemical risks are important aspects of sustainable development and promoting responsible industry.

As part of an initiative led by UNEP, a **Flexible Framework for Addressing Chemical Accident Prevention and Preparedness** *has been developed, offering* **Guidance** *for governments that wish to develop, review, or strengthen their national chemical accidents prevention and preparedness programmes.*

This **Guidance** *offers in-depth information on important elements of a Chemical Accident Prevention and Preparedness (CAPP) Programme, including the roles that industry and government should play in improving chemical safety. Additionally, it provides a roadmap, outlining a procedure for the development and implementation of an effective CAPP Programme.*

www.unep.org

United Nations Environment Programme
P.O. Box 30552 Nairobi, Kenya
Tel.: ++254-(0)20-762 1234
Fax: ++254-(0)20-762 3927
E-mail: uneppub@unep.org

UNEP

For further information, contact:

UNEP DTIE
Sustainable Consumption and Production Branch

15 rue de Milan
75441 Paris CEDEX 09
France

Tel: +33 1 4437 1450
Fax: +33 1 4437 1474
E-mail: unep.tie@unep.org
www.unep.fr/scp

ISBN: 978-92-807-3094-4
DTI/1285/PA