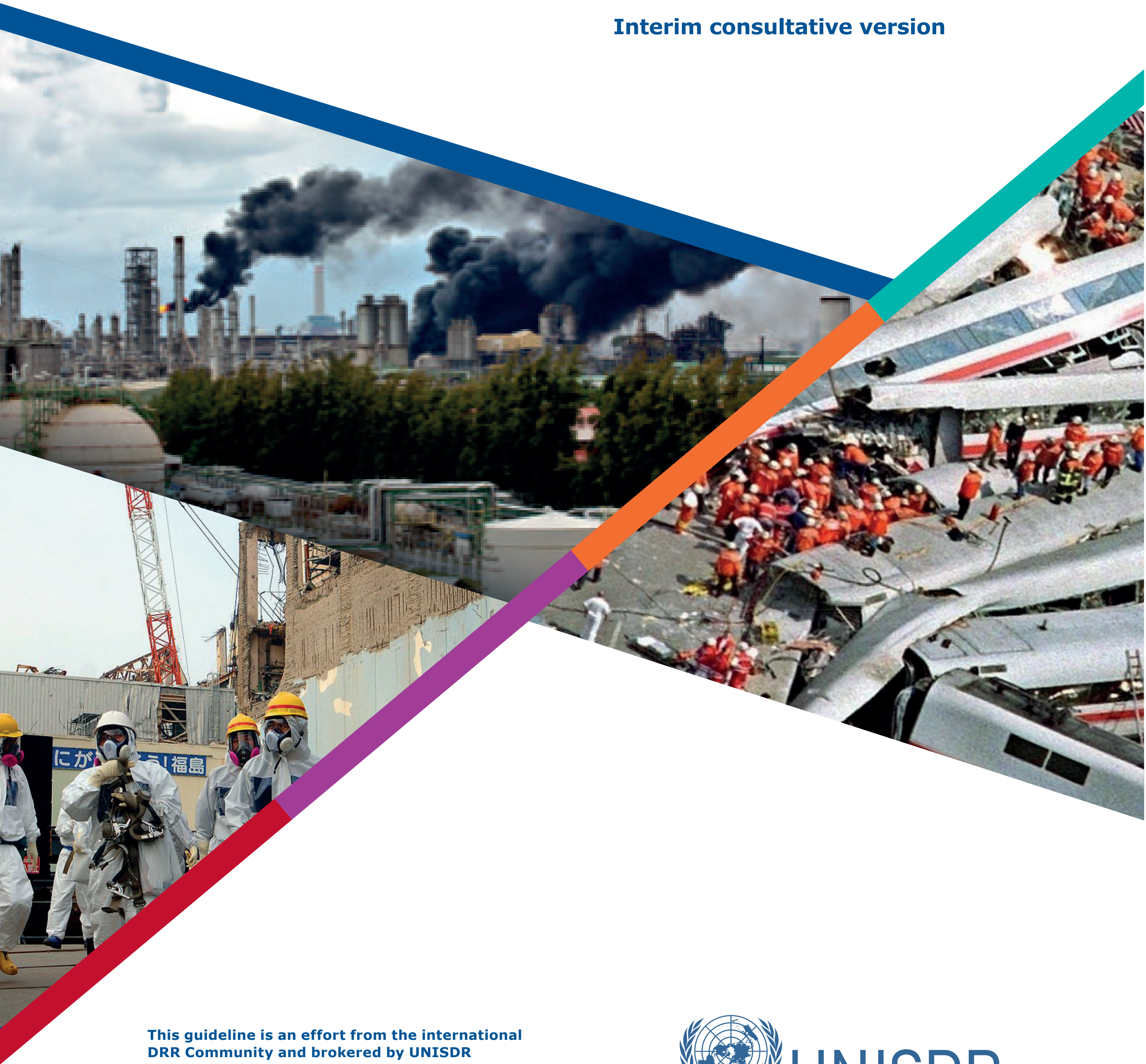
Words into Action Guidelines

Man-made/technological hazards

Practical considerations for Addressing Man-made/Technological Hazards in Disaster Risk Reduction

Interim consultative version



This guideline is an effort from the international DRR Community and brokered by UNISDR

In support of the Sendai Framework for Disaster Risk Reduction 2015 - 2030

UNISDR
United Nations Office for Disaster Risk Reduction

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List of Abbreviations

AEWS	Accident Emergency Warning System
APELL	Awareness and Preparedness for Emergencies at Local Level
ASEAN	Association of South East Asian Nations
BBB	Building Back Better
BRS	Basel, Stockholm, and Rotterdam Convention
CAPP	Chemical Accident Prevention, Preparedness (and Response; OECD)
DRR	Disaster Risk Reduction
EC	European Commission
EMSA	European Marine Safety Agency
EU	European Union
EUCP	European Union Civil Protection (Mechanism)
ECOSOC	Economic and Social Council (of the United Nations)
GIS	Geographic Information System
GSR	General Safety Requirements
HELCOM	Helsinki Commission
IAEA	International Atomic Energy Agency
IFRC	International Federation of Red Cross and Red Crescent Societies
IHM	Inventory of Hazardous Materials
IMO	International Maritime Organization
INEX	International Nuclear Emergency Exercise(s) (of OECD's NEA)
IOMC	Inter-Organisation Programme for the Sound Management of Chemicals
JEU	Joint Environment Unit (of UNEP/OCHA)
JRC	Joint Research Center of the European Commission
Man-made/ Tech	Man-made/Technological (hazards)
Natech	Natural-hazard triggered technological accident
NEA	Nuclear Energy Agency (of OECD)
NGO	Non-Governmental Organisation
NIRS	National Institute of Radiological Sciences (Japan)
NPP	Nuclear Power Plant
NR	Nuclear/Radiological
NRA	National Risk Assessment *and* Nuclear Regulatory Authority (Japan)
OCHA	Office for Coordination of Humanitarian Affairs
OECD	Organisation for Economic Cooperation and Development
OPRC (HNS)	Oil Pollution Preparedness Response and Cooperation Convention (Hazardous and Noxious Substances)
OSCE	Organisation for Security and Cooperation in Europe
RAC	Regional Action Centre
REMPEC	Regional Marine Pollution Emergency Response Centre
SIDS	Small Island Developing States
SPIs	Safety Performance Indicators
UN	United Nations
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme (UN - Environment)
UNISDR	UN Office for Disaster Risk Reduction
WHO	World Health Organization
WiA	Words into Action (Guides prepared as Sendai Framework follow-up)

Foreword

The Sendai Framework for Disaster Risk Reduction 2015-2030 agreed by Member States focuses on managing risks rather than managing disasters, with the goal to "Prevent new and reduce existing disaster risk through the implementation of integrated and inclusive measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience".

The Sendai Framework serves as a blueprint for multi-hazard disaster risk reduction factored into development at all levels and within and across all sectors. It has a wider scope covering all types of disaster risk, caused by natural or man-made hazards including biological, technological and environmental hazards.

The Sendai Framework calls upon "the United Nations Office for Disaster Risk Reduction (UNISDR), in particular*, to support the implementation, follow-up and review of this framework through* ***generating evidence-based and practical guidance for implementation in close collaboration with States, and through mobilization of experts****; reinforcing a culture of prevention in relevant stakeholders.*

To meet this demand the Words into Action Initiative (WiA) was launched to facilities developing practical guides on how to implement the different themes and aspects of the Sendai Framework. Man-made and technological hazards was identified as one of the main themes to be included in this initiative.

This is in recognition that the number and magnitude of Man-made disasters worldwide has risen since 1970s and continues to grow in both frequency and impact on human wellbeing and economic costs. Several major accidents (e.g. the Seveso disaster in 1976, the Bhopal gas tragedy in 1984, the Chernobyl accident in 1986, and Deepwater Horizon oil spill in 2010 and the increased number of new hazardous substances and materials and the opportunities for accidents has put greater attention to the need to tackle these hazards within the overall frame of inclusive disaster risk management.

UNISDR, UN Environment and OCHA have collaborated together to develop this targeted guide, which aims to strengthen national and local disaster management plans, support training and capacity building and to raise awareness for better response to the risks and impacts of Man-made and technological hazards.

This Words into Action (WiA) guide on Man-made/Technological Hazards provides a targeted set of evidence-based, practical activities for implementation at national and local levels under each of the four Priorities for Action, including chemical, industrial and transport accidents, and nuclear and radiological hazards.

The Guide also highlights the existing diversity of thematic frameworks, institutional and legal mechanisms at global and regional levels that are related to and used for addressing man-made hazards. It also draws attention to existing collaborations to implement these tools within the DRR community, including those undertaken by UNISDR and other key partners. National legislation has a key part to play in this realm, providing a vital bridge to country and local-level implementation. The guide is intended to supplement the related provisions of national and international law, regulations and recommendations.

Finally, the guide promotes and strengthen communities of practice and professional networks. It will evolve and incorporate new knowledge as needed.

UNISDR
The United Nations Office for Disaster Risk Reduction

UN environment

OCHA

Acknowledgments

The Guide is developed through strong collaboration between the UN Office for Disaster Risk Reduction (UNISDR), the United Nations Environment Programme (UN Environment) and the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) with valuable secretariat support and editorial and content inputs from UN Environment / OCHA Joint Unit.

The guide only became possible through the extensive contributions from the following partner institutions and experts that formed the drafting working group. Their inputs and dedicated involvement are greatly acknowledged.

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Introduction

The Sendai Framework for Disaster Risk Reduction (DRR) 2015-2030 was adopted at the Third UN World Conference on DRR in Sendai, Japan, on 18 March 2015. The main features of the Sendai Framework are: 1) a shift in focus from managing disasters to managing risks; 2) a wider scope which includes risk of small- to large-scale, frequent and infrequent, sudden and slow-onset disasters, caused by natural or man-made hazards, as well as related environmental, technological and biological hazards and risks; *and* 3) a more people-centered, all-hazards and multi-sectoral approach to DRR.

This Words in Action (WiA) Guide addresses man-made hazards, including the subset of technological hazards. It is one of a series of documents prepared as part of the UN Office for Disaster Risk Reduction (UNISDR) Initiative[1] supporting "the implementation, follow-up and review of the Sendai Framework by generating evidence-based and practical guidance for implementation in close collaboration with States, and through mobilization of experts; reinforcing a culture of prevention in relevant stakeholders".[2]

This WiA Guide was developed by a drafting group, consisting of government representatives and international stakeholders, and chaired by UNISDR and the UN Environment / Office for the Coordination of Humanitarian Affairs (OCHA) Joint Unit (JEU).

The Guide takes a practical approach in addressing man-made and technological (Man-made / Tech) hazards, and builds upon previous analyses and recommendations relating to such hazards in the context of DRR. The Guide builds on the outcomes of the Open-ended Intergovernmental Expert Working Group on Indicators and Terminology for the Sendai Framework, and the work on hazard classification and terminology related to human-made hazards.[3]

Man-made (i.e., anthropogenic, or human-induced) hazards are defined as those "induced entirely or predominantly by human activities and choices". This term does not include the occurrence or risk of armed conflicts and other situations of social instability or tension which are subject to international humanitarian law and national legislation. **Technological hazards**[4] are normally considered a subset of man-made hazards.

Chemical, nuclear and radiological hazards, as well as **transport hazards** are defined as those "originate from technological or industrial conditions, dangerous procedures, infrastructure failures or specific human activities. Examples include industrial pollution, ionizing radiation, toxic wastes, dam failures, transport accidents, factory explosions, fires and chemical spills. Technological hazards also may arise directly as a result of the impacts of a natural hazard event. A technological accident caused by a natural hazard is known as a Natech.[5]

[1] http://www.preventionweb.net/drr-framework/sendai-framework/wordsintoaction/
[2] Sendai Framework, Paragraph 48c
[3] http://www.preventionweb.net/english/professional/terminology/
[4] http://www.preventionweb.net/english/professional/terminology/v.php?id=488
[5] Elisabeth Krausmann, Ana Maria Cruz, and Ernesto Salzano. *Natech Risk Management: Reducing the Risk of Natural-Hazard Impact on Hazardous Installations* (Amsterdam: Elsevier, 2017), 1.

Examples for man-made hazards

- *Radiological hazard:* The Great East Japan Earthquake and Tsunami of 2011 caused severe damages at the Fukushima Daiichi Nuclear Power Plant, resulting in a large release of radioactivity into the environment. More than 100,000 people were evacuated because of the release of radionuclides to the environment[1].
- *Chemical hazard:* On 9 December 2014, an oil tanker accident in the Sundarbans of Bangladesh led to the release of approximately 350,000 litres of heavy fuel oil into the river and mangrove ecosystem which is listed as a UNESCO World Heritage and a Ramsar site.
- *Chemical hazard:* In December 1984, a major gas leak at a pesticide plant in Bhopal, India resulted in the release of 40 tons of methyl isocyanate gas. The incident caused an estimated 3,800 deaths in the immediate aftermath and a significant higher morbidity for the exposed population which the government reported to be more than 500,000 people[1].
- *Transport hazard:* In July 1978, a road tanker transporting liquefied propylene sprang a leak as it passed a camp site at Los Alfaques in Spain. The leak resulted in the release of liquefied gas into the camp site, where it immediately ignited. The explosion killed more than 200 people and the devastation spread for 400 yards in all directions.

Purpose, Objective and Scope

The **purpose** of this Guide is to:

1. Improve understanding of risk management of man-made hazards as they relate to DRR;
2. Provide practical guidance to national DRR focal points[6] and technical experts on how to address man-made hazards in the implementation of the Sendai Framework; and
3. Raise awareness of man-made hazards within the overall DRR agenda, including the challenges and opportunities in adequately addressing these.

This Guide outlines opportunities for DRR interventions focusing on the links between man-made and natural hazards. It covers the management of man-made hazards at different scales, and offers case studies from existing policies and practices.

The **focus** of this WiA Guide is on providing clear, straightforward, key considerations that can be taken up by national and local-level DRR practitioners to address man-made hazards. It is meant to provide timely, relevant and useful information to the DRR community and to support knowledge management and capacity building.

The Guide also highlights the existing diversity of thematic frameworks, institutional and legal mechanisms at global and regional levels that are related to and used for addressing man-made hazards. It also highlights existing collaborations to implement these tools within the DRR community, including UNISDR

[6] The Sendai Framework requests governments to "establish a designated national focal point" (Sendai Framework paragraph 27 g) for implementing the post-2015 framework. A National Focal Point for DRR is defined as a national governmental body and entry point responsible for the implementation, review and reporting of the Sendai Framework and is supported by the national platform for DRR http://www.preventionweb.net/publications/view/53055

and other key partners. National legislation has a key part to play in this realm, providing a vital bridge to country and local-level implementation. The guidance is intended to supplement the related provisions of national and international law, regulations and recommendations.

A selected number of man-made hazards have been chosen to illustrate the topic. These are:

1. Chemical/industrial hazards
2. Nuclear and radiological hazards
3. Transport hazards

Marine incidents are described in a separate section. By providing concrete examples of specific hazards, it is hoped that the guide will illustrate sufficiently how similar guidance can be compiled for other types of man-made hazards.

The **scope** of the WiA Guide is organized according to the four Sendai Framework priorities for action (understanding disaster risk, strengthening disaster risk governance, investing in disaster risk reduction, and enhancing disaster preparedness and "building back better"). Each of these priorities is explored in terms of how and what ***practical steps*** can be taken to better prepare for, prevent and respond to hazard events. Each sub-section includes ***case studies, which*** illustrate the "what" and the "how" of carrying out DRR-related actions for man-made hazards.

At the end of the Guide, a series of recurring themes from the Sendai Framework are described. These include: collaboration and partnerships, data access, education and training, science and technology, and the multi-hazard approach.

Overall, the Guide emphasizes the vital nature of improving current interaction between all parties and at all levels to raise the profile of man-made hazards within the DRR agenda. This is needed in order to make a visible difference in preparedness for, prevention of and response to disasters caused by man-made hazards.

Finally, the Annex provides relevant information and links to institutions, literature, resources, existing communities and networks.

Target Audience

This WiA Guide is aimed first and foremost at national DRR practitioners, including the following:

- Government planners and policy-makers working within national and local disaster risk management authorities, including national and local DRR focal points;
- DRR practitioners within international, regional and national development and humanitarian entities supporting countries on disaster and man-made risk management; and
- Technical experts working in various sectors of man-made hazard risk management, who wish to support national DRR strategies and programs.

The Guide is also intended to help UN Member States and relevant authorities take a multi-hazard approach to risk. It advocates for strengthened collaboration between the man-made and natural hazards management communities and to ultimately strengthen the involvement and accountability of all relevant stakeholders in reducing disaster risk.

How to Use this Guide

This WiA Guide on man-made and technological hazards is meant for practical use. It provides practical examples of the types of actions that can be taken to prevent or reduce the risk of man-made hazards and minimize their potential impacts on human lives, health, well-being, livelihoods, the economy and the environment.

The content was compiled on the basis of information from recognized scientific databanks of international authorities or institutions on basis of information available at the date of publication.

The guide was developed in consultation with a working group, consisting of member states representatives and international stakeholders chaired by UN Office for Disaster Risk Reduction (UNISDR) and the United Nations Environment Programme (UN Environment) / Office for the Coordination of Humanitarian Affairs (OCHA) Joint Unit (JEU). It builds on work of the Open-ended Intergovernmental Expert Working Group on Indicators and Terminology Relating to Disaster Risk Reduction[7] and takes into account the ongoing work on hazard classification and terminology related to man-made risk and provides linkages with other relevant areas and implementation guides, including “preparedness for response”, early warning, and others.

The Guide is structured around the four Sendai Framework for DRR priorities for action. Each priority is translated into practical considerations, where three types of man-made hazards are used to illustrate the case in point:

I. Chemical/Industrial hazards
II. Nuclear or radiological hazards
III. Transport hazards

Additionally, marine hazards are covered in the Sendai Framework priority 1 on “Understanding risk” in a separate section, with some case studies on marine incidents also incorporated in the sections on transport hazards.

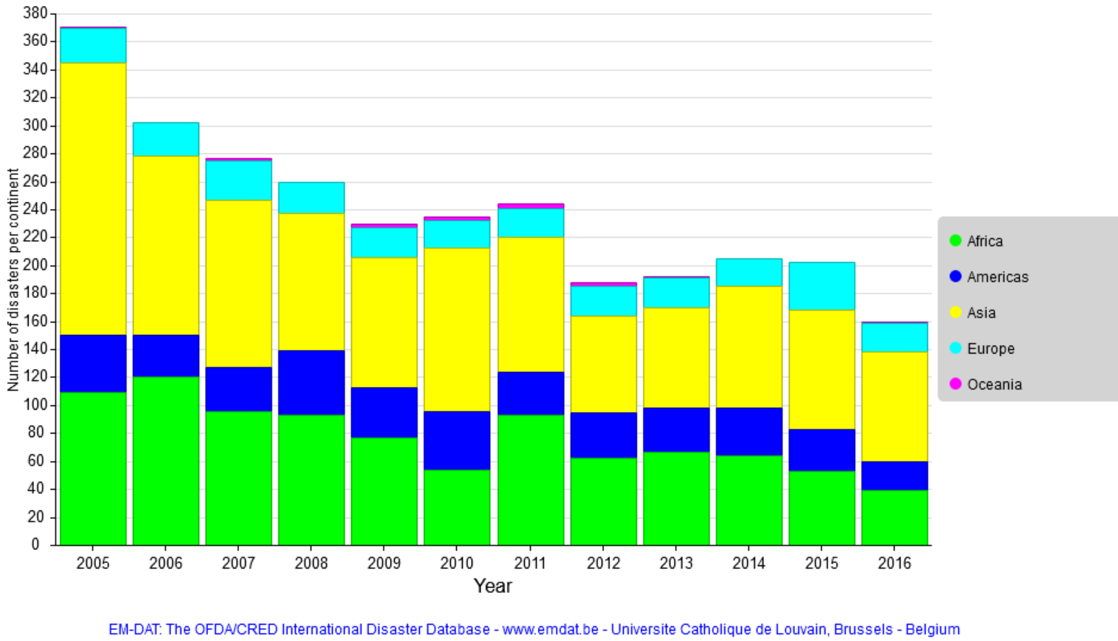
Each combination of a Sendai Framework priority and a domain is followed by at least one case study illustrating how certain practical actions and measures have been applied in various geographic locations, to provide food for thought for Man-made / Tech community stakeholders, and give ideas on how to implement the same.

The references at the end of the WiA Guide provide more detailed information to practitioners who wish to know more about key issues. Also provided is a list of existing networks and platforms which actors may join to gain greater insights into man-made hazards and their potential effects.

[7] http://www.preventionweb.net/drr-framework/open-ended-working-group/

The "Business Case"

Man-made hazards – when materializing as industrial, nuclear or transport accidents – have the potential to cost lives, cause injuries, impact livelihoods, jeopardize long-term wellbeing and cause environmental damage. There is therefore a strong "business case" for paying more attention to man-made hazards and integrating these into an all hazard approach for disaster risk management.



For example, in 2015 massive explosions at a chemical warehouse in Tianjin, China reportedly killed 139, injured over 700 and displaced 6,000 people. The same year, a tailings dam failure in Bento Rodrigues, Brazil, released nearly 50 million tons of toxic iron ore waste into the Doce River, affecting the lives of hundreds of thousands of people downstream. What is still considered the worst industrial accident of all time, a gas leak of methyl isocyanate (MIC) at the Union Carbide pesticide plant in Bhopal, India in early December 1984 killed an estimated 16,000 people and injured up to 560,000, with nearly 4,000 of them suffering permanent disabilities. In 1989, the Union Carbide Corporation (UCC) paid $470m (US $907m in 2014 dollars) to settle litigation stemming from the disaster.

In the Tauerntunnel fire in Austria in May 1999, a lorry carrying paint crashed into surrounding cars inside the tunnel, resulting in the deaths of 12 persons, injuries to 50 others and the closure of the tunnel for three months, with an economic cost of €8,670,000 million (equivalent to approximately US$9,700,000 million, May 2017) for the reconstruction and renovation of the tunnel. In 1998, a truck carrying sodium cyanide plunged off a bridge in Kyrgyzstan releasing approximately 1,800 kg of highly toxic sodium cyanide into a river upstream of several villages. Not only did hundreds of people require medical treatment due to contamination of the water, but the effects on local fauna and fauna were considered disastrous.

In the United Kingdom, the average economic costs of a major industrial accident, excluding environmental costs, have been estimated in 2016 at £95,000,000 in injuries and fatalities, £3,300,000 in building damage, £4,500,000 in business disruption and £2,100,000 in emergency services.[8]

Accidental releases of radioactive material can affect millions of people and lead to major economic costs. The Chernobyl accident caused the deaths of 30 power plant employees and firemen (including 28 deaths that were due to radiation exposure) within the first few days and weeks, brought about the evacuation of about 116,000 people from areas surrounding the reactor during 1986, and the relocation, after 1986, of about 220,000 people from what were at that time three constituent republics of the Soviet Union: Belorussia, the Russian Soviet Federated Socialist Republic (RSFSR) and the Ukraine.[9] In the aftermath of the Fukushima Daiichi accident in March 2011, more than 100,000 people were evacuated because of the release of radionuclides to the environment[10]. Estimates of the total economic loss from the accident are still taking place and have already been noted as significant.[11]

National disaster risk reduction strategies and policies offer an opportunity both to reduce the risk and impacts of such accidents, and to mitigate their impacts when they do, by addressing man-made hazards as part of overall inclusive disaster risk management.

[9] http://www.unscear.org/docs/reports/2000/Volume%20II_Effects/AnnexJ_pages%20451-566.pdf
[10] IAEA, The Fukushima Daiichi Accident, Report by the Director General http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1710-ReportByTheDG-Web.pdf
[11] The Fukushima Daiichi Accident, Technical volume 5/5 Post Accident Recover Section 5.5 http://www-pub.iaea.org/MTCD/Publications/PDF/AdditionalVolumes/P1710/Pub1710-TV5-Web.pdf

PART 1: Means of integrating and mainstreaming Man-made/Tech Hazards in DRR[12]

The need for focused action within and across sectors, and at multiple levels of governance (local, national, regional and global) are reflected in the four Sendai Priority Areas for Action. This section outlines ***key considerations*** within each of the four Priority Areas. The following subsets of man-made hazards are used to illustrate the case:

- Chemical/Industrial hazards
- Nuclear and Radiological hazards
- Transport hazards

I. SENDAI FRAMEWORK PRIORITY FOR ACTION 1 ON "UNDERSTANDING RISK"

Disaster risk is defined as "the potential loss of life, injury, destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity.[13]

Understanding disaster risk in its various dimensions (vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment) is necessary in order for new and effective policies and practices for disaster risk management to be developed and implemented. Such knowledge can include pre-disaster risk assessments and is used for prevention and mitigation, but also for the development and implementation of appropriate preparedness and effective response to disasters.[14]

Key Considerations and activities for better understanding risk include, but are not limited to, the following:

- Conducting and ensuring access to pre-disaster risk assessment[15] information:
  - Having a baseline for hazards, exposure, risks and vulnerability, including local sources/potential hazard sites
  - Collecting information on local institutions, capacities and plans to address disasters;
- Developing and regularly updating local and national maps on disaster risk, hazards, human exposure and vulnerability, including key infrastructure elements;
- Engaging with communities at risk to understand community structures, involve formal and informal leaders;
- Ensuring access of communities to risk information and supporting community inclusiveness;
- Enhancing understanding of disaster risks among all stakeholders, including government officials at all levels, civil society and non-governmental organizations (NGOs), local communities, the private sector and responders/volunteers;
- Improving the flow of disaster risk information from scientific and technical experts to policy-makers, communities and other stakeholders, and assure appropriate use of the same;

[12] Much of the text in Section I above is paraphrased from the Sendai Framework.
[13] UNISDR Terminology 2017 http://www.preventionweb.net/english/professional/terminology/v.php?id=488
[14] http://www.preventionweb.net/risk
[15] http://www.preventionweb.net/publications/view/52828

- Strengthening understanding of disaster at the local level through education and awareness-raising campaigns; and
- Applying risk information in all its dimensions to develop and implement DRR policies and strategies.

A. Understanding risk: The case of chemical/industrial hazards

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, such as loss of containment of hazardous substances, explosions, and fires".[16] The impact at a local level of a chemical or industrial accident can be significant for the surrounding community, and may also lead to contamination having a substantial and long-term impact on the environment and livelihoods.

Key Considerations and activities for better understanding the risk of chemical/industrial accidents[17] include, but are not limited to, the following:

- Identifying, understanding and prioritizing hazards and risks at national and local levels, determining what related public authority bodies and resources exist, and where gaps remain. This could be done by establishing criteria for identifying hazardous installations considered to have the potential to cause accidents, as well as a system to obtain information concerning certain specified categories of hazardous installations;
- Establishing effective public governance for chemical/industrial accident prevention, preparedness and response; including land-use planning, inspection strategies, trans-boundary issues, involvement and communication with the public, and accident follow-up;
- Ensure adequate communication on risk amongst stakeholders, including corporate management in hazardous facilities, public authorities, academia, labour unions, international organizations, NGOs, community representatives and the media;
- Timely and effective sharing of data between relevant authorities and stakeholders (i.e., information on the location of hazardous facilities, residential areas, critical infrastructure including utilities, transportation routes, medical facilities, schools and vulnerable environmental sites); and
- Preparing and making available procedures and communication materials for relevant stakeholders such as responders, public health authorities and the public on what actions to take in case of an accident;
- For industry, developing a strong operational safety culture in facilities, which is at the heart of business operations, and understanding the risks posed by organizational activities dealing with hazardous substances

[16] OECD Guiding Principles on Chemical Accidents Preparedness, Prevention and Response, 2003
[17] The terms “chemical accident” and “industrial accident” are used interchangeably in this Guide.

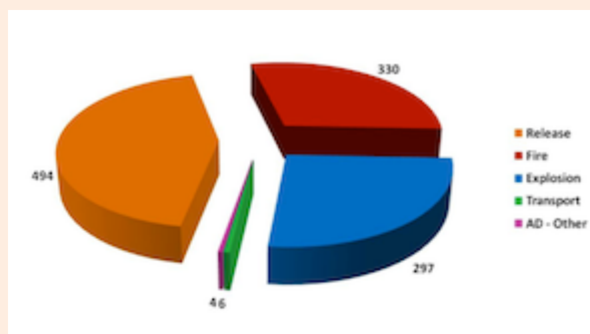
Case study: Protecting the Danube Delta from industrial accidents

Under the United Nations Economic Commission for Europe's (UNECE) project on hazard and crisis management in the Danube Delta (2010–2015),[18] a hazard map was developed by the Republic of Moldova, Romania and Ukraine indicating hazardous facilities in the Danube Delta. The project aimed at protecting the Danube Delta from industrial accidents and to improve cooperation on industrial accidents between the three countries. It sought to enhance and, where possible, harmonize the mechanisms and approaches for efficient and effective hazard and crisis management. As a result of the cooperation, a joint agreement between the three project countries was drafted. Another goal was to improve understanding between authorities and industrial operators and strengthen their cooperation. In terms of hazard sources, the project focused specifically on the oil terminals located in all three countries directly above the Delta. These terminals generate an increased hazard potential for the ecosystem and natural heritage of the Delta.

See: http://www.unece.org/env/teia/ap/ddp.html

Learning from past events with eMARS

The Major Accident Reporting System (eMARS) facilitates the exchange of lessons learned from accidents and near misses involving dangerous substances in order to improve chemical and industrial accident prevention and mitigation of potential consequences. It was established by the EU Seveso Directives and contains reports of chemical accidents and near misses provided to the Major Accident and Hazards Bureau of the European Commission's Joint Research Centre from EU, OECD and UNECE countries (under the Convention on the Transboundary Effects of Industrial Accidents). Reporting an event in eMARS is compulsory for EU member States when a so-called "Seveso establishment" is involved and the event meets the criteria of a "major accident" as defined by Annex VI of the Seveso III Directive (2012/18/EU). For non-EU OECD and UNECE countries, the reporting of accidents in the eMARS database is voluntary. The information of the reported event is entered directly by the official reporting authority of the country in which the accident occurred.



See: https://emars.jrc.ec.europa.eu/

[18] http://www.unece.org/env/teia/ap/ddp.html

B. Understanding risk: The case of nuclear or radiological hazards

Emergency is sometimes used interchangeably with the term disaster, as, for example, in the context of biological and technological hazards or health emergencies, which, however, can also relate to hazardous events that do not result in the serious disruption of the functioning of a community or society[19].

The International Atomic Energy Agency (IAEA) defines an *emergency* as a non-routine situation or event that necessitates prompt action, primarily to mitigate a hazard or adverse consequences for human life, health, property or the environment.[20] This includes nuclear and radiological emergencies. It also includes situations for which prompt action is warranted to mitigate the effects of a perceived hazard. A nuclear or radiological emergency is an emergency in which there is, or is perceived to be, a hazard due to the energy resulting from a nuclear chain reaction or from the decay of the products of a chain reaction, or radiation exposure.[21]

Appropriate authorities should act to ensure that arrangements are in place to provide communities and the local and regional public who are affected or potentially affected by a nuclear or radiological emergency with information that is necessary for their protection; for potential protective actions and other response actions to be taken; and to warn them promptly and to instruct them on any actions to be taken.

Key Considerations[22] and activities for better understanding the risk of a nuclear or radiological hazard include, but are not limited to, the following:

- Identify hazards and assess potential consequences of an emergency. This provides a basis for establishing arrangements for preparedness and response for a nuclear or radiological emergency, which should be commensurate with the hazards identified and the potential consequences of an emergency;
- Ensure that a hazard assessment is performed to provide a basis for a graded approach in preparedness and response for a nuclear or radiological emergency;[23]
- Evaluating the impacts of emergencies on the population and the environment, taking into account not only direct radiation effects, but also non-radiation health, social and psychological effects associated with human exposure and vulnerability; and
- Prepare information about the location of sites where hazardous radioactive substances are stored or used and of nuclear facilities in the area, and making this information publicly available where possible;
- Use evidence-based risk analysis (estimates) and risk communication to ensure that comprehensive radiation risk management is effective and credible;
- Familiarize relevant authorities with the International Nuclear and Radiological Events Scale[24] as a tool to communicate to the public the severity of nuclear and radiological events – and applying this scale in the event of a nuclear or radiological emergency[25];

[19] UNISDR Terminology 2017 http://www.preventionweb.net/english/professional/terminology/v.php?id=475
[20] "IAEA Safety Glossary," (2016 revision), 50.
[21] Ibid, 51.
[22] "Preparedness and Response for a Nuclear or Radiological Emergency," General Safety Requirements No. GSR Part 7, (IAEA Safety Standards, 2015).
[23] A graded approach is a step-by-step process that identifies key areas of assessment, where the highest areas of risk are expected, directs effort in the area of commensurate risk potential, and seeks to minimize the overall cost of the assessment. "Use of a Graded Approach in the Application of Safety Requirements in Research Reactors," (IAEA Safety Standards, 2012).
[24] http://www-ns.iaea.org/tech-areas/emergency/ines.asp

- Include societal and risk perception factors into communication materials; and
- Raise awareness for potential cross-border effects of radiological hazards and integrating this information into emergency planning.

***Case study*: Nuclear legacy waste mapping in Central Asia**

In most of the Central Asian countries, uranium mining and milling was an intensive industry that has left a legacy of radioactive residues. Following the collapse of the former Soviet Union, development of most uranium deposits was stopped in the countries of Uzbekistan, Tajikistan, Kyrgyzstan and partially in Kazakhstan. Many of the countries containing sites affected by the operation of uranium mining and milling facilities required safe management and remediation. This posed challenges to the Central Asian countries, as the issue of government restructuring and decommissioning of the mines and uranium facilities arose at the same time.

Many of the uranium legacy sites are located adjacent to tributaries in the upper reaches of the watershed, which has led to concerns regarding adverse environmental impacts and exposure to populations living nearby and downstream. Radiological hazards can pose protracted management issues, including long-term exposure hazards. Acknowledging the toxic and chemical hazards from heavy metals associated with uranium wastes are of equal concern. Recognizing trans-boundary risks to surrounding communities can also improve communication among actors and avoid international disputes.

One of the important tasks for past, present and future uranium-producing Member States of the IAEA is the safe management of uranium mill tailings. Therefore, in collaboration with the governments and the IAEA, and with support from additional international organizations, including the European Commission, UN Development Programme, and the Organization for Security and Cooperation in Europe (OSCE), an initiative[26] was developed in order to create a common understanding of the risks posed by these sites. With the aim of protecting the populations and environment, the objective of the initiative included developing a document that provided a technical framework for managing regional and site-specific issues.

[25] The Use of the International Nuclear and Radiological Event Scale (INES) for Event Communication (http://www-pub.iaea.org/MTCD/Publications/PDF/INES_web.pdf)

[26] https://gnssn.iaea.org/RTWS/general/Shared%20Documents/Remediation/Remediation%20Evaluation%202012/AssessmentandProposalsforUraniumProductionLegacySitesinCentralAsia.pdf.

C. Understanding risk: The case of transport hazards

For the purposes of this Guide, transport accidents cover the types of accidents involving dangerous goods and hazardous substances[27], which occur during transport, whether by road, rail or pipeline. Maritime transport incidents are described as a separate subset of transport accidents.

The terms dangerous goods and hazardous substances are used interchangeably and encompass all materials which may, by nature or when released in specific quantities or forms, pose an unacceptable risk to health, safety, property or the environment.

Transport of dangerous goods is regulated in order to prevent, as far as possible, accidents to persons, property or the environment, the means of transport employed or to other goods. Transport regulations are, at the same time, framed so as not to impede the movement of such goods, other than those too dangerous to be accepted for transport. With this exception, the aim of the regulations is to make transport feasible by eliminating risks or reducing them to a minimum. It is thus a matter of safety as well as one of facilitating transport.

Key Considerations and activities for better understanding the risk of transport accidents include, but are not limited to, the following:

- Using containment systems of good quality, adapted to the danger presented by the goods to be transported and compatible with them, meeting the construction requirements and the performance tests or other tests contained in the UN Model Regulations on the Transport of Dangerous Goods;[28]
- Understanding the safety requirements needed for various types of goods carried (e.g. tank-vehicles, holds of ships, maritime or inland navigation tankers);
- Establishing good operational practices;
- Ensuring that only those dangerous goods which are properly classified, packaged, marked, labeled, placarded, described and certified on a transport document, in accordance with the applicable transport of dangerous goods regulations are accepted for transport;
- Setting up an adequate hazard communication system (labeling, marking, placarding, documentation) which provides appropriate information to all involved particularly to:
    - Transport workers involved in dangerous goods handling
    - Emergency responders who have to take immediate action in case of incidents or accidents
- Developing and implementing effective control and enforcement by competent authorities:

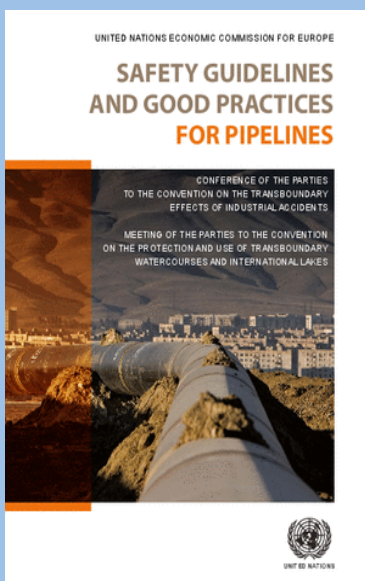
[27] "Dangerous goods and hazardous substances" include explosives and gases, flammable and oxidizing substances, toxic and infectious substances and articles, radioactive and corrosive, environmentally hazardous and miscellaneous dangerous substances and articles. These substances are regulated to prevent accidents to persons and property and damage to the environment. They are defined and classified by type of danger presented, *see* "United Nations Recommendations on the Transport of Dangerous Goods Model Regulations" (UN, 2015).

[28] These should be adapted, as appropriate, to withstand stresses, impacts and other wear and tear to which packages may be submitted during normal conditions of transport. Failure of containment systems can lead to leakage or spillages or even explosion of the containment system itself in case of pressure build-up.

- Ensuring that the appropriate security measures for dangerous goods in transport by all modes are considered and that the applicable transport security threshold for high consequence dangerous goods are observed[29]
    - Ensure adherence to the provisions of the IAEA's 'Regulations for the Safe Transport of Radioactive Material'

- Ensuring that all persons engaged in the transport of dangerous goods receive the appropriate training in the contents of dangerous goods requirements commensurate with their responsibilities. In case this training has not yet been provided, they only perform their functions under the direct supervision of a trained person.[30]

***Case Study*: Pipeline Transport Accidents**



Transport accidents also include the transport of hazardous substances by **pipeline**. Pipelines throughout the UNECE region transport large volumes of hazardous substances, such as crude oil, its derivatives, and natural gas. They are essential for the industrial and energy sectors and help to meet the needs for heat and energy for a large part of the region's population. If pipelines are constructed, monitored, operated and maintained as required by international and national legislation and according to national and international industry standards and good practices, they can be safe and environmentally sound. However, they can also represent a serious risk to human health and the environment. External interference, corrosion and poor maintenance are the most common causes of pipeline accidents in the UNECE region. Uncontrolled loss of containment, fires or explosions can lead to the loss of human life, accidental water pollution and major environmental catastrophes - as demonstrated by a number of pipeline accidents in the past two decades. In response to the need to improve pipeline safety, UNECE member States decided to develop safety guidelines and good practices for pipelines[31] jointly under two UNECE conventions: The Convention on the Transboundary Effects of Industrial Accidents (Industrial Accidents Convention) and the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention).

See: http://www.unece.org/fileadmin/DAM/env/documents/2015/TEIA/publications/Pipelines-Layout-WEB.pdf

[29] "High consequence dangerous goods" are those that have the potential for misuse in a terrorist event and which may, as a result, produce serious consequences such as mass casualties or mass destruction, or particularly for radioactive material, mass socio-economic disruption.
[30] More specific requirements for training are described in the applicable modal regulations (e.g: ADR, RID, ADN (for land transport); IMDG Code for maritime transport, ICAO Technical instructions for air transport).
[31] http://www.unece.org/index.php?id=41068

D. Marine Pollution Hazards

Marine pollution incidents resulting in oil pollution or the release of other harmful substances into the marine environment can have widespread impacts, not just to the territory of individual states, but also to neighboring states. The source of marine pollution hazards events may be from fixed shoreline locations such as seaports, oil handling facilities, pipelines and offshore units, or from ships, due to collision for grounding.

The International Maritime Organization (IMO) is the global standard-setting authority for the safety, security and environmental performance of international shipping. Since it was established in 1958, IMO has adopted a wide range of measures to prevent and control pollution caused by ships and to mitigate the effects of any damage that may occur as a result of maritime operations and accidents. IMO promotes cooperation between countries through bi-lateral, multi-lateral and regional agreements to support the implementation of the provisions of the OPRC Convention and OPRC-HNS Protocol. Along with supporting agencies such as UN Environment, IMO works with several Regional Activity Centres (RACs) addressing preparedness and response activities related to marine pollution incidents, including the Regional Marine Pollution Emergency Response Centre (REMPEC).

Several IMO Conventions are particularly relevant to marine pollution incidents, including the 1990 International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC), and the 2000 Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances (OPRC-HNS), which together provide a framework for the development of a national response system and a platform for facilitating international cooperation and mutual assistance at the time of a marine incident. In relation to marine pollution incidents, a systematic approach covering prevention and preparedness activities, as part of the risk reduction process is included.

In the event of a spill, a timely and effective response aimed at addressing immediate impacts and reducing the consequences to the environment is required. The key element in the ability to effectively respond to a marine pollution incident is the existence of an exercised and tested contingency plan that links the risk of a spill, with the ability to respond, taking into consideration the threat to the environment. The plan should be developed based on identified risk scenarios and matched to an appropriate response strategy and capability, with established procedures for mobilizing external assistance through a tiered preparedness and response approach.

Key Considerations to be taken into account include, but are not limited to the following:

- Use real-time data, hazard mapping, modelling, sensitivity maps and other information and communication systems and technological innovations to build knowledge about Marine Pollution Incidents
- Develop of a national system for responding promptly and effectively to pollution incidents, through the creation of a national contingency plan, the designation of national authorities responsible for preparedness and response that will act as operational contacts points and will have authority to request or render assistance to other state parties.

- Development of marine pollution emergency response plans for all potential sources of pollution, coordinated with the national response system
- Establishing marine pollution reporting procedures as well as a commitment to inform all states whose interests may be affected by a pollution event.
- Establishing, individually or through bilateral or multilateral co-operation a minimum level of pre-positioned response equipment commensurate with the identified risk, a program of exercises and training, a mechanism for incident response, and detailed plans and communication capabilities for incident response.
- Risk reduction at the international level is achieved through strengthened shipping policy of IMO conventions based on practical experience and lessons learned that is then translated by States into national legislation and programs (e.g. double hulls)

***Case study*: HELCOM (Baltic Marine Environment Protection Commission - Helsinki Commission)**

HELCOM is the governing body of the Convention on the Protection of the Marine Environment of the Baltic Sea Area, known as the Helsinki Convention. HELCOM was established in 1974 to protect the marine environment of the Baltic Sea from all sources of pollution through intergovernmental cooperation. As part of its activities, HELCOM undertakes specific projects to understand risk. The HELCOM Baltic SCOPE[32] project focuses on planning various marine-based activities such as shipping, fishing, offshore wind farming and protected areas – more specifically, should such activities possibly co-exist or be separated in different parts of the marine areas. Importantly, the planning of the common sea area is to be a coordinated effort. The project is comprised of two case studies that build upon marine spatial planning processes. The first encompasses the Baltic Sea's southwest area and affects the countries of Sweden, Denmark, Germany and Poland. The second project comprises the marine area between Estonia, Latvia, and Sweden. The project includes the use of maritime GIS data, especially on ship movements in the region based on the HELCOM Automatic Identification System (AIS) network. Both case studies focus on how shipping traffic, energy production, fishing, and environment function work together to attain compromise.

See: http://www.helcom.fi/helcom-at-work/projects/baltic-scope

[32] http://www.balticscope.eu/

II. SENDAI FRAMEWORK PRIORITY FOR ACTION 2 "STRENGTHENING DISASTER RISK GOVERNANCE TO MANAGE DISASTER RISK

Improved governance of disaster risk is vital for more effective and efficient disaster risk management at local, national and global levels. The strengthening of disaster risk governance for prevention, mitigation, preparedness, response, recovery and rehabilitation benefits from greater collaboration across mechanisms and institutions in implementing DRR measures.

This section on Sendai Framework priority 2 - Strengthening Governance for Disaster Risk - addresses all stages of disaster risk management, from prevention to mitigation, preparedness and response to recovery. Since all levels of government and societal sectors are concerned, approaches should be designed to mainstream DRR through legal frameworks and policies, and DRR strategies and plans drawn up and implemented for man-made hazards.

Key Considerations and activities for strengthening governance include, but are not limited to, the following:

- Mainstreaming DRR within and across all sectors dealing with man-made hazards, through relevant legal frameworks, policies, regulations, reporting requirements and compliance incentives;
- Ensuring that sectors involved in man-made risk management are involved in appropriate DRR coordination and organizational structures, including forums and platforms at local and national levels;
- Ensuring that sectors involved in man-made risk management adopts and applies national and local DRR strategies and plans, including targets, indicators and timeframes, and follow-up mechanisms to assess progress; and
- Assigning clear roles and tasks to relevant national and local authorities, community leaders and other stakeholders in operationalising strategies/plans, while reinforcing the role of the appropriate national authority(-ies) as the primary one responsible for DRR.

A. Strengthening risk governance: The case of chemical/industrial hazards

The potential for major industrial accidents has become greater with the increasing production, storage and use of hazardous substances. Major accidents as well as smaller, recurrent chemical accidents cause severe harm to workers, communities, municipalities, businesses and the environment. Consequently, a systematic approach to controlling hazardous substances is needed. Central to such an approach is strengthening the governance framework, which can be achieved through the development of a national chemical accidents program and adapted to a country’s specific circumstances. Effective governance on process safety is essential both for a sustainable business performance and to minimize the frequency and severity of chemical and industrial accidents. Good governance is particularly important when siting hazardous industrial activities, making changes to such activities, and when planning land use around existing sites, for example, for housing, schools, hospitals and other public services as well as infrastructure development.

Key Considerations and activities for strengthening governance for chemical/industrial risk include, but are not limited to, the following:

- Integrating emergency planning for chemical and industrial accidents into local and national DRR and emergency plans and updating these plans on a regular basis;
- Making use of relevant guidance, such as the "OECD Guiding Principles for Chemical Accidents Prevention, Preparedness and Response", which aims to help public authorities, industry and communities worldwide to prevent chemical/industrial accidents and improve preparedness and response, should an accident occur;
- Ensuring involvement of all relevant stakeholders and public authorities in the governance of chemical and industrial accidents;
- Furthering the cooperation and coordination of government authorities to improve information sharing and enable effective management across the whole risk management spectrum;
- Developing the inspection and supervision capacity of government authorities and other sectors involved with assessing progress;
- Initiating a process for developing, implementing and reviewing laws, regulations, policies, guidance and other instruments, as part of an effective chemical/industrial accidents governance program;[33] and
- Guaranteeing that operators (international companies, local companies and government-owned enterprises) of chemical/industrial facilities operate to the same highest standards of safety, accept responsibility for chemical and industrial accident risk management at the highest level of the organization. This includes the setting of clear policies by senior leaders, where public authorities should make this expectation known and part of a clear risk management enforcement strategy.[34]

Case study: **the Flexible Framework for Chemical Accident Prevention and Preparedness (CAPP) in Tanzania**

Over 90% of chemicals used by companies in Tanzania are imported. Many chemical spillage accidents have been reported in road transport of substances by fuel tankers and trucks. These accidents have resulted in fires, and frequently, human fatalities.

Recognizing the need to improve the sound management of chemicals, the Government Chemist Laboratory Agency (GCLA), the implementation Agency for Industrial and Consumer Chemicals in Tanzania, in collaboration with UN Environment and the Swiss Federal Office for the Environment (FOEN), initiated the Chemical Accident Prevention and Preparedness (CAPP-TZ) programme project in Tanzania, in order to prevent and prepare for major chemical and industrial accidents in Tanzania.

While policies, regulations and guidelines for the proper management of chemicals existed in Tanzania, there was an acknowledged need to improve the compliance and enforcement of laws, cooperation/coordination between stakeholders, and greater awareness among stakeholders about existing legislation for improved management. The collaboration among multiple levels of governance provided a positive setting for the development of policies to improve chemical and industrial safety and the safety of local communities nearby areas of potential risk.

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[33] Such a process typically includes development of commitments and mechanisms for coordination, prioritization of hazards within a region, determination of required resources, implementation of management plan as well as the periodic review and update of the plan. See the Chemical Accidents section of the Inter-Organization Programme for the Sound Management of Chemicals (IOMC) Toolbox. For more details: http://iomctoolbox.oecd.org/default.aspx?idExec=fa0a7540-917a-4cd2-b316-c1454399e6f5.

[34] OECD (2013), Corporate Governance for Process Safety: Guidance for Senior Leaders in high Hazard Industry, OECD, Paris, https://www.oecd.org/chemicalsafety/chemical-accidents/corporate%20governance%20for%20process%20safety-colour%20cover.pdf

See: http://www.capp.eecentre.org/upload/images/proj_Tanzania_InceptionReport.pdf

***Case study:* Coordination between authorities on land-use planning in Estonia.**
The Estonian Rescue Board (crisis management department and regional and local rescue centres) is responsible for prevention and emergency preparedness for industrial accidents. The Board is actively involved in siting and land-use procedures, related environmental impact assessment and strategic environmental assessment processes, including screening and scoping, and has a number of binding powers in this respect.

Comprehensive, special or detailed spatial plans and building design documentation must be submitted to the Board for approval when:
(a) Selecting the location of a new establishment;
(b) Expanding the operations of an existing establishment or increasing production, provided that a plan needs to be initiated or amended or a building permit needs to be granted;
(c) Planning an area located in the danger zone of a hazardous enterprise, an enterprise with a major hazard, or planning construction works there.

The Board assesses whether:
(a) The plan or construction works increase the major-accident hazard or the severity of its consequences;
(b) The planned accident prevention measures are sufficient;
(c)The operator of the establishment also submits must submit additional information to the local authority and to the Board before the plan is adopted or the building permit is granted.

The Board may reject a proposal if a planned activity in the plan or in the building design documentation increases the risk of a major accident occurrence, or the severity of its consequences, and the planned accident prevention measures are insufficient.

Source: excerpt from Guidance on land-use planning, the siting of hazardous activities and related safety aspects (UNECE, forthcoming in 2017).[35]

B. Strengthening risk governance: The case of nuclear and radiological hazards

Throughout the world, but particularly in technologically-advanced countries, there are a large number of nuclear installations. Regulatory bodies require that site-specific emergency preparedness and response plans are developed and maintained for these installations. There are also many other types of facilities and activities that involve the use of radiation or radioactive material for agricultural, industrial, medical, scientific and other purposes. Such facilities and activities include, for example, the production, use, import and export of radiation sources; the transport of radioactive material; the decommissioning of facilities; or satellites carrying radioactive material.

Governments and regulatory bodies have an important responsibility to establish both standards and the regulatory framework for protecting people and the environment against the risks associated with ionizing radiation exposure. An effective legal and governmental framework for safety, including an independent regulatory body, must be established and sustained. However, the prime responsibility for safety of the facility and radiation sources rests with the licensee.

[35] The draft guidance is available at http://www.unece.org/environmental-policy/conventions/industrial-accidents/envteiaguidelines/envteialup.html and, once published in late 2017, it will be available at http://www.unece.org/environmental-policy/conventions/industrial-accidents/publications.html.

Effective national and international preparedness and response capabilities are essential to minimize the impacts from nuclear and radiological emergencies and to build public understanding of the safety and security measures for nuclear technology.

The IAEA acts as the global focal point for international emergency preparedness, communication and response to nuclear and radiological incidents and emergencies resulting from the civil use of nuclear technology. The IAEA helps maintain and strengthen effective emergency preparedness and response capabilities on a national and international level. As part of these activities, it develops safety standards, guidelines and technical tools; assists Member States in building the capacity for emergency response; and maintains the IAEA Incident and Emergency System to efficiently implement its role in response to nuclear or radiological incidents and emergencies.

Key Considerations and activities for strengthening governance for nuclear and radiological risk include, but are not limited to, the following:[36]

- Ensuring that an integrated and coordinated emergency management system for preparedness and response for a nuclear or radiological emergency is established and maintained;
- Making adequate preparations to anticipate, prepare for, respond to and recover from a nuclear or radiological emergency at the operating organization, local, regional and national levels, and also, as appropriate, at the international level. These preparations include;
    - Establishing and maintaining an effective legal and governmental framework for safety at all levels, including an independent regulatory body[37]
    - Adopting international obligations and standards within the legal system, as may be necessary to fulfill all national responsibilities, and ensuring their effective implementation
    - Ensuring that all roles and responsibilities for preparedness and response are clearly allocated among operating organizations, the regulatory body and response organizations
- Ensuring that operating organizations, response organizations and the regulatory body establish, maintain and demonstrate leadership in relation to preparedness and response for a nuclear or radiological emergency;
- Confirming that action programs are put in place to reduce radiation risks, which include emergency actions such as monitoring releases of radioactive substances to the environment and properly disposing of radioactive waste; and
- Providing for control of sources of radiation for which no other organization has responsibility, such as some natural sources, 'orphan sources' and radioactive residues from some past facilities and activities.

[36] Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards, General Safety Requirements No. GSR Part 7, IAEA, 2015

[37] This framework provides for the regulation of facilities and activities that give rise to radiation risks and for the clear assignment of responsibilities

***Case Study*: The Nuclear Regulatory Authority and local centres in Japan**

Following the Fukushima, Japan nuclear power plant (NPP) accident, the Nuclear Regulation Authority (NRA) was established in 2012 as an independent commission under the Ministry of the Environment. Thus, all nuclear regulatory functions are integrated (safety, security and safeguard), and separate from NPP promotion.[38]

The NRA's core values and principles are as follows:

- learn and absorb lessons from Fukushima Daiichi accident and never allow such accidents to happen again;
- restore public trust;
- foster a genuine radiation safety and protection culture; and
- achieve genuinely effective regulations, independent decision-making based on scientific and technological information and free from any outside pressure and bias follow high ethical standards, sense of mission and rightful pride as an open and transparent organization.

As part of NRA activities, local centres in Japan have been put in charge of developing and implementing preparedness and evacuation guidelines for local communities. In addition to the National Institute of Radiological Sciences (QST-NIRS), Hirosaki University, Fukushima Medical University, Hiroshima University and Nagasaki University have been designated as Nuclear Disaster Medical Care/General Support Centres. Serving dual purposes, these five institutions are designated as Advanced Radiation Emergency Medicine Support Centres, and also respond to nuclear disasters in the event of another NPP accident.

See: https://www.nsr.go.jp/english/

C. Strengthening risk governance: The case of transport hazards

The transport of dangerous goods or hazardous materials can occur by various modes (air freight, road, rail and inland waterways). In case an accident occurs, these can have critical impacts on communities and the environment near to the area of an incident. In industrial areas or transport hubs there is also a risk of cascading effects, which need to be considered when managing risk. It is thus highly important to identify the actions and technologies capable of reducing accidents and improving safety.

Integrated risk management includes effective national and international preparedness and response capabilities, combined with improved monitoring and spatial planning networks. When effectively implemented, these minimize the impacts from transport accidents and serve to protect people and the environment against risks from such events.

The "Recommendations on the transport of dangerous goods, Model Regulations"[39] developed under the umbrella of the United Nations' Economic and Social Council (ECOSOC) aim at ensuring a high level of safety by preventing accidents to persons and property and damage to the environment during transport, while providing a uniform regulatory framework that can be applied in all countries for national or international transport, by any mode of transport.

[38] https://www.nsr.go.jp/english/index.html
[39] http://www.unece.org/trans/danger/publi/unrec/rev13/13nature_e.html

The Recommendations cover the classification of dangerous goods, their listing, the use, construction and testing and approval of packaging and portable tanks, as well as consignment procedures such as marking, labeling, placarding and documentation. They are presented as "Model Regulations", to facilitate their direct integration into all modal, national and international regulatory instruments. The International Maritime Dangerous Goods Code (IMDG Code) for maritime transport, the ICAO Technical Instructions for the Safe Transport of Dangerous Goods for air transport; the Agreements or regulations concerning the international carriage of dangerous goods by road (ADR),[40] by rail (RID)[41] and by inland waterways (ADN)[42] integrate the provisions of the Model Regulations, thereby enhancing international harmonization. The Model Regulations are also extensively used worldwide as the basis for the development of national legislation on the transport of dangerous goods.

Key Considerations and activities for strengthening risk governance in the transport of dangerous goods domain include, but are not limited to, the following:

- Ensuring that an integrated and coordinated emergency management system for preparedness and response to transportation accidents is established and maintained;
- Making adequate preparations to anticipate, prepare for, respond to and recover from a transport accident at the organizational, local, regional and national levels, and, as appropriate, at the international level. These preparations shall include adopting legislation and establishing regulations for effectively governing the preparedness and response for a transport accident at all levels *(see "C. Strengthening risk governance: The case of transport* hazards*" paragraph on "Model Regulations" above as well as Key Considerations under sub-section A iv Transport); and*
- Ensuring that all roles and responsibilities for preparedness and response for a transport accident are clearly allocated in advance among operating organizations, the regulatory body and response organizations.

***Case Study:* Coordination of major accidents' prevention for the transport of dangerous goods by rail with spatial planning in Switzerland**

Switzerland's Ordinance on the Prevention of Major Accidents (MAO)[43] establishes the basis for the cooperation of all actors in the area of major accident prevention. It sets targets not only for stationary installations, but also for transport and pipeline systems. Since Switzerland's population density is increasing, it is obvious that an accident in a factory or on a transport route could cause harm to a greater number of people. Hence, the coordination of major accidents' prevention with spatial planning is becoming ever-more important when it comes to minimizing the potential damage arising from a major accident. The Swiss Federal Office for the Environment (FOEN) and the Federal Office for Spatial Development have been working together to ensure that the prevention of major accidents is given greater consideration in spatial planning.

[40] http://www.unece.org/trans/danger/publi/adr/adr_e.html
[41] http://www.cit-rail.org/en/rail-transport-law/cotif/
[42] http://www.unece.org/trans/danger/publi/adn/adn_e.html
[43] https://www.admin.ch/opc/en/classified-compilation/19910033/index.html

Since April 2013, the MAO has been updated with a new article 11a requiring coordination with land use planning. The coordination process has been further specified in a guideline.[44] Toxic, explosive and otherwise highly reactive substances do not only pose a risk in local stationary contexts; they also - and in particular - harbour risks during transport. For this reason, the authorities have developed, in a cooperative process with the railway companies, instruments for identifying the risks arising from the transport of dangerous goods. By use of these instruments, it was determined in 2011 that the risks will become unacceptable for the transport of chlorine gas by rail from Geneva into the canton of Valais along Lake Geneva in approximately 10 to 20 years, due to planned settlement developments. In 2016, the FOEN and a broad-based working group signed a joint declaration, in which the objectives and risk reduction measures were agreed to avoid unacceptable risks resulting from the transport of chlorine gas in the future.[45] The adopted measures include provisions for better-equipped tank wagons, slower travelling speeds and other operational precautions. In addition, the industry will undertake to verify whether its shipments could not be routed through more sparsely populated areas.

See: https://www.bag.admin.ch/bag/en/home/themen/mensch-gesundheit/chemikalien/nanotechnologie/sicherer-umgang-mit-nanomaterialien/stoerfallvorsorge-nanomaterialien.html

***Case Study:* European Maritime Safety Agency (EMSA)**

The European Maritime Safety Agency (EMSA) was created (EC 1406/2002)[46] in 2002 following two marine accidents, Erika (1999) and Prestige (2002) and their subsequent oil spills, which resulted in large economic and environmental damage to the coastlines of Spain and France. EMSA has established a network of stand-by oil spill response vessels through contracts with commercial vessel operators. In the event of an oil spill, and following a request for assistance, the maximum time for an oil spill response vessel to be ready to sail is 24 hours.

EMSA participates in regional agreements to coordinate preparedness and response efforts in case of a large-scale marine pollution incident; these include the Bonn Agreement, the Helsinki Convention (HELCOM), the Barcelona Convention and the Lisbon Convention. Recognizing that information exchange and addressing issues of common interest in the field of marine pollution, preparedness and response are vital to capacity building, EMSA works in a variety of international fora and in coordination with the IMO, the Emergency Prevention, Preparedness and Response Working Group and others.

In 2009, EMSA's CleanSeaNet satellite monitoring system identified an oil spill off the southern coast of Ireland while a Russian tanker was undergoing refuelling. EMSA notified the Irish authorities who deployed the Irish Coast Guard to confirm the incident. Initial estimates place the spill at approximately 400-500 tonnes, covering an eight by one km area. EMSA deployed a pollution response vessel to remain on standby, and the Irish authorities worked with local authorities to implement emergency response plans for cleaning the affected areas.

See: http://www.emsa.europa.eu/csn-menu.html
http://www.emsa.europa.eu/csn-menu/csn-service/oil-spill-detection-examples.html

[44] http://www.bafu.admin.ch/publikationen/publikation/01741/index.html?lang=fr
[45] https://www.newsd.admin.ch/newsd/message/attachments/45484.pdf
[46] http://www.emsa.europa.eu/operations/pollution-response-services.html

Case Study:* the Global Ballast Water Management Programme (GloBallast)

The problem of invasive marine species has been identified as one of the greatest global threats to oceans and marine ecosystems. A few examples of major invasive species that have severely impacted numerous marine locations are the zebra mussel, the North American comb jelly and the North Pacific seastar, all of which were transported in ships' ballast water from one oceanic region to others.

Such invasive species not only represent a major threat to both marine and freshwater ecosystems around the globe, but can also lead to serious economic, environmental and human health impacts. Reduced fisheries production, competition or elimination of local species, damage to aquaculture, beach closures and disease outbreaks are some of the major impacts that have been experienced due to invasive species.

To help cope with and reduce such impacts, the International Maritime Organization (IMO) introduced the GloBallast Partnerships' Programme with support from the Global Environment Facility (GEF) and UNDP. The main purposes of this project that began in 2000 are to catalyse innovative global partnerships and sustain momentum in tackling the invasive species problem stemming from ballast water. GloBallast directly assists developing countries to reduce the transfer of harmful aquatic organisms from one global ocean to others; expanding government and port management capabilities; aiding relevant national legal, policy and institutional reforms; and supporting regional coordination and cooperation in these areas. Currently, GloBallast is focusing on 15 Lead Partnering Countries (LPCs) in Africa, Europe and particularly Latin America & Caribbean.

GloBallast has already delivered results in the LPCs in the form of National Ballast Water Management Strategies, and the naming of Lead Agencies and National Task Forces. Most of the LPCs have completed a National Ballast Water Status Assessment and a related Economic Assessment. While much work remains to be done to address the marine invasive species problem - estimated by IMO to cause some $100 billion per year in socioeconomic costs - GloBallast would appear to be heading in the right direction.

See: http://globallast.imo.org

** Extracted from the UNDP-GEF publication entitled "International Waters - delivering results"; Jan. 2016; 76 pages.*

***Case Study*: UNECE's Inland Transport Committee and Dangerous Goods Transport**

Following the 2009 Viareggio, Italy train derailment and explosion of flammable gases, and the 2011 capsizing of the Waldhof tank-vessel in the Rhine River that led to significant disruption of navigation, transport safety levels reflected new opportunities for improvement.

A meeting of the Inland Transport Committee shortly following the Rhine accident included participation by authorities from UNECE governments, the IMO, the Central Commission for the Navigation of the Rhine, the European Commission, the European Chemical Industry Council, the International Road Transport Union, and the International Union of Railways.

The discussions of the Inland Transport Committee reflected that the mechanisms to regulate the transport of dangerous goods lead to a high level of safety when effectively implemented by governments. Training and the improvement of technical capacity are additional methods to strengthen safety and security in the transport of dangerous goods.

See: https://www.unece.org/fileadmin/DAM/press/pr2011/11trans_p02e.htm

III. SENDAI PRIORITY FOR ACTION 3: INVESTING IN DISASTER RISK REDUCTION FOR RESILIENCE

Prevention and reduction of disaster risk can be fostered through private and public investment, including structural and non-structural measures. Investment in the form of human and financial resources is essential for enhancing the economic, social, health and cultural resilience of persons, communities, countries and the environment. Investment are not only cost-effective, but also vital for preventing and reducing losses and saving lives.

Investing in DRR is a cross-sectoral and multi-level effort. This means that investments must be made in all sectors of the society and at all levels – including local, national to regional levels. A multi-faceted approach is required which involves many types of actions and stakeholders. In addition to prevention and preparedness, investments should also cover the recovery and rehabilitation from man-made disasters.

Key Considerations and activities for investing in DRR for man-made hazards include, but are not limited to, the following:

- Ensure the allocation of financial and logistical resources to implement DRR plans, policies and strategies at national and local levels;
- Promote disaster risk financial sharing/transfer and insurance mechanisms;
- Strengthen public and private sector investments to prevent and reduce the impacts of man-made disasters, including their impact on critical infrastructure and other sites;
- Improve building codes and standards and enforce specific standards in the construction of all technological facilities;
- Invest in appropriate land use, local planning and zoning policies in relation to location of technological facilities;
- Enhance the resilience of national health care systems to deal with specific hazard types and enhance local access to basic health care services and social safety-net mechanisms for post-disaster assistance for populations at risk from man-made disasters; and
- Protect the most disadvantaged persons, along with livelihoods and productive assets, including major earning sectors like tourism from man-made hazards.

A. Investing in DRR for resilience: The case of chemical/industrial hazards

Investing in resilience means that chemical safety should be an integral part of all phases of the development of a hazardous facility: from choosing and planning the location, design and construction, through operation and maintenance, to decommissioning/closure/demolition. This also means that chemical accidents prevention and response should be part of sound chemicals management, not only to prevent injury, save lives and protect the environment, but also to safeguard the viability of emerging economies and to maintain the economic viability of the enterprises concerned.

Key considerations and activities for investing in resilience in the chemical/industrial accident domain include, but are not limited to, the following:

- Making resources available to capture, analyse and learn from adverse or unexpected outcomes, in order to improve prevention and response. Enhancing learning from past events and incidents, recognising that many accidents have similar underlying causes;
- Advancing and improving the use of inherently safer technologies;
- Investing in and conducting land-use planning assessments prior to development of infrastructure near to facilities containing hazardous substances; and
- Developing and using Safety Performance Indicators (SPIs) to help measure the effects of investment in resilience. SPIs are used to assessing performance related to the prevention of, preparedness for and response to chemical accidents. As such, they improve the ability of industry, public authorities and community organizations to measure whether steps taken to reduce the preparedness and response to accidents lead to safer communities and reduced risks to human health and the environment.[47]

Case Study: **Upgrading infrastructures and retrofitting chemical industries: taking earthquakes into consideration**

Switzerland's Ordinance on the Prevention of Major Accidents (MAO)[48] aims at protecting the population and the environment from severe damage due to major accidents that may occur during the operation of facilities. It establishes the basis for the cooperation of all actors in major accident prevention. Article 3 of the MAO stipulates that *"The owner of an establishment shall take all appropriate measures that are available to reduce risk in accordance with the state of the art of safety technology, supplemented by personal experience, and which are economically viable. These shall include measures to reduce the hazard potential, to prevent major accidents and to limit the impacts thereof..."* This means that facility owners must keep installations up-to-date on a permanent basis in order to keep risk as low as possible. This includes seismic design of infrastructures, since seismic risk is considered as a possible cause of major accidents. This process is controlled by federal and cantonal-level authorities.

The MAO, through a two-step process, classifies establishments in two categories: the low risk establishments that don't have the potential for severe damage (with a Major Accident Index <0.3, which represents less than 10 potential fatalities) and the high risk establishments (with a MAI >0.3, requiring detailed risk studies).[49] For low risk establishments, two standards apply for seismic design/verification: SIA 261[50] (current building codes for new establishments) and SIA 2018[51] (since 2004, the code for seismic verification and retrofit of existing buildings). For high-risk establishments, no existing codes are currently

[47] OECD (2003), Guidance on Safety Performance Indicators for Industry, OECD, Paris, see https://www.oecd.org/chemicalsafety/chemical-accidents/41269710.pdf
OECD (2003), Guidance on Safety Performance Indicators for Public Authorities and Communities, OECD, Paris, see https://www.oecd.org/chemicalsafety/chemical-accidents/41269639.pdf
[48] https://www.admin.ch/opc/en/classified-compilation/19910033/index.html
[49] Evaluation Criteria
[50] SIA 261
[51] SIA 2018
Internet link : Seismic retrofitting of Structures - Strategies and collection of examples in Switzerland

available. Thus, the current practice shows either that the seismic risk is inadequately addressed (if seismic risk is taken into consideration in risk studies, the risk is unacceptable according MAO criteria) or that the building codes are applied outside their scope of application.

This inconsistent approach led to investing in a research project aiming at defining clear guidelines on how to integrate seismic risk into new and existing high-risk establishments. This project is currently running and involves federal, cantonal and industry stakeholders. The intermediate results of this project show that increasing seismic design factors alone is not sufficient to reach an acceptable level of risk, but that a risk-based approach must be taken in order to define further measures that will reduce the damage potential (e.g., hazardous substances reduction, implementation of passive technical measures).

***Case study:* Tailings management**

Failures at Tailings Management Facilities – where mine waste is held – may lead to major environmental catastrophes with devastating effects on humans and the environment both within and across countries, as demonstrated by major past accidents such as the dam break of a tailings pond at a mining facility in Baia Mare (Romania, 2000), the aluminum sludge spill in Kolontar (Hungary, 2010), the accident at the Talvivaara Mining Company (Finland, 2012) and the Bento Rodrigues disaster (Brazil, 2015) mentioned in the introduction.

In response to needed improvements in the safety of tailings management facilities, UNECE member States decided to develop safety guidelines and good practices for tailings management facilities under two UNECE Conventions — the Convention on the Transboundary Effects of Industrial Accidents (Industrial Accidents Convention) and the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention). The guidelines and good practices were published in 2014. In addition, a methodology for tailings safety – comprised of a tailings hazard index, and checklists and measures catalogue – was developed and tested within a project on improving tailings safety in Ukraine, financed by Germany under the framework of the Industrial Accidents Convention in 2013-2015. The methodology provides a practical tool for application by operators and competent authorities to reduce the risks posed by tailings management facilities.

See: https://www.umweltbundesamt.de/en/publikationen/improving-the-safety-of-industrial-tailings
http://www.tmf-ukraine.org

B. Investing in DRR for resilience: The case of nuclear and radiological hazards

For an efficient national and international response to nuclear or radiological emergencies, it is important to invest in the adequate implementation of international safety standards.[52] Harmonization of emergency preparedness and response arrangements and capabilities requires close collaboration and coordination among responsible authorities within a country and internationally.

Key considerations and activities[53] for investing in resilience in the nuclear and radiological hazards domain include, but are not limited to, the following:

- Ensuring that authorities for preparedness and response for a nuclear or radiological emergency are clearly established and adequately resourced;
- Strengthen investment in response organizations, operating organizations and the regulatory body to ensure necessary human, financial and other resources, in view of their expected roles and responsibilities and the assessed hazards, to prepare for and to deal with both radiological and non-radiological consequences of a nuclear or radiological emergency, whether the emergency occurs within or beyond national borders; and
- Ensuring that arrangements are in place for effectively providing prompt and adequate compensation of victims for damage due to a nuclear or radiological emergency.

***Case Study*: The Chernobyl Recovery and Development Programme (CRDP)**

The CRDP was developed in 2002 by the United Nations Development Programme (UNDP) and sought to ensure the return to normal life as a realistic prospect for people living in regions affected by the Chernobyl disaster. The CRDP offers ongoing support to Ukraine's government to elaborate and implement development-oriented solutions for the affected areas. The CRDP was launched based on the recommendations of a 2002 joint UN agency report "The Human Consequences of the Chernobyl Nuclear Accident a strategy for Recovery".[54]

Since 2003, the CRDP has acted to reduce long-term economic, environmental and social consequences of the Chernobyl catastrophe; rebuild infrastructure and create more favorable living conditions; and promote sustainable human development in the Chernobyl-affected regions. Partnerships have been formed with international organizations, oblasts, rayons and state administrations, village councils, scientific institutions, non-governmental organizations and private business. These partnerships allow the CRDP to support community organizations and help them to implement their initiatives for economic and social development, and environmental recovery. Aside from these activities, the CRDP distributes information about the Chernobyl catastrophe internationally and within Ukraine.

See: https://web.archive.org/web/20090621222509/http://www.crdp.org.ua:80/en/

[52] Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards, General Safety Requirements No. GSR Part 7 (IAEA, 2015).
[53] Ibid.
[54] http://chernobyl.undp.org/english/docs/Strategy_for_Recovery.pdf

C. Investing in DRR for resilience: The case of transport hazards

Investing in DRR in the transport domain means involving actors from land-use planning, the transportation sector, and local and national governments and financial institutions. Pursuing improved land-use development, enforcing disaster-resilient infrastructure, and fostering collaboration among stakeholders is vital to building resilient transportation systems.

Key considerations and activities for investing in resilience in the transport domain include, but are not limited to, the following:

- Making resources available to capture, analyse and learn from adverse or unexpected outcomes, in order to improve prevention and response. Integrate the "lessons learned" approach from past transport incidents, recognising that many accidents have similar underlying causes;
- Invest in development of inspection and supervision capacity of government authorities, making regular updates to local emergency response plans possible;
- Ensuring that all transport operators (international companies, private companies and government-owned enterprises) operate to the same highest standards of safety;
- Promoting integration of land use planning and zoning allowing for improved development codes that are applicable within a high-population density and marginal human settlement context. Surveying and enforcing codes with a view to fostering disaster-resilient infrastructure; and
- Promoting the mainstreaming of disaster risk assessments into land-use policy development and implementation, including urban planning and land degradation assessments. Ensuring that follow-up tools are informed by anticipated demographic and environmental changes.

***Case Study*: U.S. Investment in Rail Corridor Risk Management Systems**

In 2008 U.S. legislation mandated that railroads implement Positive Train Control (PTC) technology on main lines used to transport passengers and toxic-by-inhalation materials. PTC technology is designed to stop or slow a train automatically before certain types of accidents occur, including train-to-train collisions, derailments caused by excessive speed, unauthorized incursions by trains into maintenance areas and switches left in the wrong position. The law requires full implementation by 2015, but the rail industry has worked to require higher safety standards than the government currently legislates, which has leveraged new types of innovation among rail companies.

Developed in coordination with the U.S Department of Homeland Security, the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration and the Federal Railroad Administration, the Rail Corridor Risk Management (RCRM) System is also being integrated by railroads to help determine the statistical routing of hazardous substances on routes that pose the least overall safety and security risk.

In addition to the RCRM System, additional investment activities in DRR include increasing trackside safety technology, increasing the number of track inspections, integrating emergency response training and developing emergency response capability plans.

IV. SENDAI FRAMEWORK PRIORITY FOR ACTION 4: ENHANCING DISASTER PREPAREDNESS FOR EFFECTIVE RESPONSE AND BUILD BACK BETTER IN RECOVERY, REHABILITATION AND RECONSTRUCTION

Capacities for effective response and recovery at all levels should be put in place. Increasing population density, urbanization and pressures from a rapidly changing environment, including the effects of climate change, showcase need to take concrete measures that improve preparedness and ensure that capacities are in place to effectively respond and recover at the local and national level to Man-made / Tech hazard events. The concept of "Building Back Better" is to make communities and nations more resilient to disasters, including by integrating DRR into recovery, rehabilitation and reconstruction and development.[55]

Key Considerations and activities related to enhancing disaster preparedness and building back better include, but are not limited to, the following:

- Developing and updating disaster preparedness and contingency policies, plans and programs at regional, national and local levels, involving relevant authorities in a whole of government, whole of society approach;
- Developing and maintaining multi-sectoral rapid alert systems and robust means of communicating warnings to the public when an incident occurs;
- Promoting the resilience of key infrastructure such as emergency centres, roads and water treatment plants, that are critical in preparing for and responding to man-made disasters;
- Conducting targeted training for emergency workers e.g. first responders, medical staff, public service and voluntary workers who deal with specific man-made disasters and emergencies;
- Organizing and conducting periodic disaster preparedness, response and recovery exercises and evacuation drills; and
- Promoting cooperation among multiple authorities, relevant institutions and stakeholder groups to assure a smooth and effective Man-made / Tech disaster response.

A. Enhancing preparedness and building back better: The case of chemical/ industrial hazards

Enhancing emergency preparedness requires cooperation among various stakeholders including, amongst other things, response personnel, health personnel, the private sector and representatives of the public and the media. For chemical accidents, industry has the primary responsibility for on-site planning, and public authorities have primary responsibility for off-site planning. The main principles to follow are available in OECD's "Guiding Principles for Chemical Accidents Prevention, Preparedness and Response" and in the chemical accidents scheme of the IOMC Toolbox.

Key Considerations and activities related to enhancing preparedness for chemical/industrial accidents and building back better include, but are not limited to, the following:

- Ensuring preparedness policies, plans and programs address cascading events, such as natural-hazard triggered industrial accidents (Natechs), and other accidents that can lead to the release of hazardous substances;

[55] WiA guide on preparedness for effective response http://www.preventionweb.net/publications/view/53347

- Developing minimum standards and guidelines beyond the national level and ensure they are implemented (i.e., industry, international/regional environmental standards, sector-specific guidelines, or others as applicable). Information to include are the composition of response teams, type of response strategy, equipment needed and stand-by or ready-to-deploy mechanisms;
- Integrating chemical / industrial accident preparedness plans into development frameworks, with focus on vulnerable areas;
- Establishing appropriate communication and early warning systems between public authorities and the general public. Ensuring the general public is informed about potential chemical and industrial hazards and is engaged in emergency preparedness measures and response through, for example, a national educational campaign on specific chemical- and industry-related hazards and how to act in the event of such an accident;
- Developing capacity of national governments to improve contingency planning and response to chemical and industrial emergencies;
    - Developing joint public and private capacity building projects to support emergency preparedness and contingency planning at the local and national level
    - Liaising with organizations working in a specific domain to implement workshops aimed at strengthening preparedness for chemical and industrial accidents
- Regularly review and update plans, conducting preparedness exercises and simulations. Incorporate lessons learnt from past emergencies and accident; and
- Increasing collaboration among private, public and government actors, where preparedness programs can be funded through a variety of national governments and civil society organizations. Pilot projects are suggested if none currently exist.

***Case Study:* APELL Campos Elíseos, Brasil**

Associação das Empresas de Campos Elíseos (ASSECAMPE)[56] is an association of ten companies of the oil, natural gas, chemical and petrochemical sectors that have fifteen plants in an industrial zone called Campos Eliseos in the municipality of Duque de Caxias, in the State of Rio de Janeiro, Brazil. Duque de Caxias is a dense populated area vulnerable to natural and human-related hazards.

Since 2001, ASSECAMPE manages and financially supports the improved preparedness of local communities for emergency response, based on UN Environment's Awareness and Preparedness for Emergencies at Local Level (APELL) process. Over the last 15 years, the effectiveness of the APELL Programme in local communities' preparedness to respond to man-made disasters has been regularly demonstrated.

The Secretariat of Civil Defense of Duque de Caxias has made great efforts to empower the community to be involved in emergency response and improve their own safety.

Numerous programs of Duque de Caxias municipality resulted in the training of more than 20,000 people in local communities. Around 1,500 community volunteers, along with industry and governmental agencies personnel participate and are trained in each Annual Exercise of the APELL-CE. In addition, more than 5,500

[56] www.assecampe.com.br/quem-somos/apell/o-que-e-apell/.

training certificates have already been issued for competencies such as Safety Health and Environment (SHE), Civilian Firefighter, Search and Rescue, Water rescue, and Aid and Assistance in Disasters.

See: http://www.assecampe.com.br/quem-somos/apell/grapa/

Case Study: **UNECE Industrial Accident-related Conventions**

To respond effectively and in a coordinated way to an industrial accident with trans-boundary effects, countries must be informed as soon as possible, since time is of the essence. The **UNECE Convention on the Transboundary Effects of Industrial Accidents** consequently calls on its Parties to set up special notification systems. With this in mind, the **UNECE Industrial Accident Notification System** was developed and accepted by the Conference of the Parties. It includes forms for giving early warning, providing information and requesting assistance. This system makes it easier for a country where an industrial accident has taken place to notify all others that could be affected and give them the information they need to fight its possible effects. Since 2008, the System has been operated through an Internet application, and is linked with other such systems.

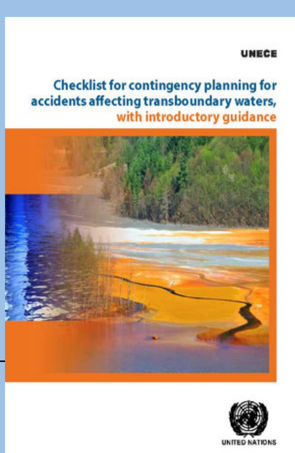
See: http://www.unece.org/fileadmin/DAM//env/teia/archive/IAN%20System/systemE.htm

Case Study: **Regional, Trans-boundary Early Warning System**

The Accident Emergency Warning System (AEWS)[57] of the Danube River Basin is activated whenever there is a risk of trans-boundary water pollution, or threshold danger levels of certain hazardous substances are exceeded. The AEWS sends out international warning messages to countries downstream to help authorities put environmental protection and public safety measures into action. The system underwent a major test in 2000, during the Baia Mare and Baia Borsa spill accidents on the Tisza River. The AEWS operates on a network of Principal International Alert Centres in each of the participating countries. These centres are made up of three basic units: (i) Communication Unit (operating 24 hours a day), which sends and receives warning messages; (ii) Expert Unit, which evaluates the possible trans-boundary impact of any accident using the database of dangerous substances and the Danube Basin Alarm Model; and (iii) Decision Unit, which decides when international warnings are to be sent A similar system is in place for the Rhine River.

See: https://www.icpdr.org/main/activities-projects/aews-accident-emergency-warning-system

Case Study: **Water and Industrial Accidents**



Contingency Planning is complex as it involves the coordination of many actors. This complexity increases further in a trans-boundary context, with actors from two or more countries being involved. A Joint Expert Group on Water and Industrial Accidents under two UNECE conventions - the Convention on the Transboundary Effects of Industrial Accidents (Industrial Accidents Convention) and the Convention on the Protection and Use of Transboundary Watercourses and International Lakes - has prepared a checklist for contingency planning for

57 activities-projects/aews-accident-emergency-warning-system

accidents affecting trans-boundary waters,[58] by far the most common medium for the effects of an industrial accident to cross national borders. The checklist is intended to contribute to mitigating the severity of the consequences of industrial accidents affecting trans-boundary watercourses for human health and the environment. Although focused on trans-boundary cooperation in relation to watercourses, the checklist is of value for all types of contingency planning.

See: https://www.unece.org/fileadmin/DAM/env/documents/2016/TEIA/ece.cp.teia.34.e_Checklist_for_contingency.pdf

***Case Study:* Comprehensive emergency preparedness in Armenia**

Armenia, and specifically the Ministry of Emergency Situations and Territorial Administration, has been working to strengthen its preparedness to chemical accidents with support of the United Nations Development Programme (UNDP), the Joint Environment Unit (JEU) of UN Environment and the Office for the Coordination of Humanitarian Affairs, Switzerland and the European Commission Directorate-General European Civil Protection and Humanitarian Aid Operations Programme (DG ECHO). As part of this work, missions and workshops with main stakeholders have been organized where main gaps and needs have been identified and presented to the Government for further reflection where particularly the absence of industrial risk modelling was considered a major gap. A pilot project was designed which would set up the necessary institutional procedures for multi-risk modelling and risk information which in turn would serve as the basis for relevant institutional and legislative changes. Trainings on the Flash Environmental Assessment Tool (FEAT) were organized in partnership with the Crisis Management State Academy (CMSA), UNDP and the JEU with FEAT integrated into the educational curriculum of CMSA. To date, more than 150 representatives of different state institutions, local organizations and NGOs dealing with DRR have since completed these trainings. As a follow-up to this work, in 2016 UNDP initiated the project[59] “Strengthen Community-based Resilience and Environmental Emergency Preparedness Capacities in Armenia”, funded by DG ECHO. The project seeks to develop comprehensive and comparable risk profiling at the local level and to incorporate disaster risk management into development planning and budgeting. Based on GIS based multi-risk profiling a population protection plan is being developed for Kapan and will form the basis for risk-informed development. The establishment of early warning systems will ensure the timely dissemination of information related to environmental emergencies to trigger appropriate actions for civil protection and evacuation. The FEAT is used as formal impact assessment tool, facilitating risk-informed management for all stakeholders, while also considering environmental protection.

See: http://www.eecentre.org/?p=1117

[58] http://www.unece.org/index.php?id=44290
[59] http://www.arnap.am/?p=4951&lang=en

***Case study:* Preparedness and Response in Antamina Mine (Peru)**

Antamina established a specialized team prepared to respond to contingencies inside or outside of operating facilities. The number of communities involved in the TransAPELL program started with seven communities in 2006, and expanded to 17 communities in 2016, including the local and provincial elected authorities, primary and secondary schools, medical posts and police stations along over 250 km of road. Over the last 10 years' implementation of TransAPELL, 17,855 people have been trained and made aware of the risks to which they are vulnerable in their communities.

In addition, Antamina adopted UN Environment's APELL program as part of its strategic corporate planning. Resulting from awareness-raising activities on hazards and risks in the communities, volunteers from each community can be trained to become members of "Community Brigades". The combination of volunteer participation and personal commitment by members of the communities involved has made the APELL program viable now as well as sustainable in the long run.

Antamina recognized the importance of developing partnerships for creating preventive measures, which became the key element of the company's strategy for responsible mining. As a result, local communities, suppliers and transporters are fully engaged, enabling the development of appropriate local emergency preparedness and response plans.

See: http://www.transapell.net/transapell0752.html

***Case Study:* The Global Initiative for West, Central and Southern Africa (GI WACAF)**

The GI WACAF Initiative is a regional project under the Global Initiative program aimed at improving regional expertise and spill response capacity in West and Central Africa by assisting in the development of regional, sub-regional and national capacities in oil spill preparedness and response through industry and government cooperation. The GI WACAF program was initiated in 1996 by IMO and IPIECA (the global oil and gas industry association for environmental and social issues) to address an increased level of oil spill risk due to higher levels of shipping traffic, and increased exploration and production activities across the region.

The GI WACAF, covering 22 countries, aims to achieve a comprehensive preparedness and response system in accordance with international guidelines. Specifically, the GI WACAF's mission focuses on promoting the ratification of relevant key international conventions; strengthening existing regional and sub-regional agreements; assisting in the development of national oil spill contingency plans on regional, national and local levels; and assisting in the development of regional, sub-regional and national capacities.

The GI WACAF has supported the development of National Oil Spill Contingency Plans within the countries, as well as promoting and facilitating the establishment of bilateral cooperation between neighboring countries. This approach has provided a framework for the countries to cooperate on oil spill preparedness and response and promote effective and efficient movement of relevant resources and personnel across international borders in the case where assistance is needed.

See: http://www.giwacaf.net/en/

B. Enhancing preparedness and building back better: The case of nuclear and radiological hazards

Effective national and global preparedness and response capabilities are essential to minimize the impacts from nuclear and radiological emergencies and to build public awareness on safety and security measures related to nuclear technology.

Preparedness for a nuclear or radiological emergency may involve many national organizations (e.g., the operating organization and response organizations at the local, regional and national levels), as well as international organizations. The functions of many of these organizations may be the same for the response to a nuclear or radiological emergency as for the response to a conventional emergency, but might also require some specific knowledge, equipment and training for the same organizations.

However, the response to a nuclear or radiological emergency might also involve specialized agencies and technical experts. Thus, in order to be effective, the response to such an emergency must not only be well-coordinated, but these emergency arrangements must also be well-integrated with response measures to a conventional emergency and with those for nuclear security and safety.

It is of utmost importance that the communities at risk are included in the preparedness and response planning to assure that local capacities and considerations are appropriately taken into account.

Key Considerations and activities[60] related to enhancing preparedness for nuclear and radiological emergencies and building back better include, but are not limited to, the following:

- Ensuring that policies, plans and procedures are in place for the coordination of preparedness, response and recovery for a nuclear or radiological emergency between the operating organization and authorities at the local, regional and national levels, and, where appropriate, at the international level;
- Improving awareness and communication regarding emergency warning systems and emergency plans for nuclear or radiological emergencies, including:
    - Information on protective actions such as sheltering or evacuation – depending on the location and severity of the emergency
    - Ensuring credible and reliable information pre- and post-crisis
- Consistently promote resilience through careful measuring and assessing of radiological impacts arising from nuclear or radiological emergencies; covering both the emergency and post-emergency periods;
- Ensuring that roles and responsibilities for preparedness and response and recovery from a nuclear or radiological emergency are clearly specified and assigned based on a multi-hazard assessment and graded approach. The available capacities and resources of local actors have to be specifically taken into account;
- Developing international partnerships to support national, regional and global vocational and training institutions. This fosters relationships with professionals capable of engaging in disaster and

[60] Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards, General Safety Requirements No. GSR Part 7, IAEA, 2015.

radiation-related interventions, for example in aiding in the protection and recovery of evacuees, and in offering medical and safety support during emergencies;

- Organizing and conducting regular drills and exercises with relevant personnel to ensure that they are able to perform their assigned response functions effectively in a nuclear or radiological emergency; and
- Promoting cooperation and collaboration among relevant international organizations in preparing for a nuclear or radiological emergency.

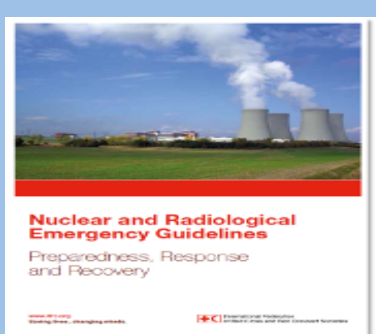
***Case Study:* Vocational Training and Capacity Development in Japan**

A few Japanese universities have initiated post-graduate courses to train professionals to engage in nuclear disaster risk management and recovery, including Nagasaki University, Hiroshima University and Fukushima Medical university.

The vocational training establishes a network among the research institutions in order to develop cross-cutting studies through knowledge integration of many specialists in basic sciences, clinical research, epidemiology and social sciences – all essential for research in disaster recovery and clinical applications pertaining to nuclear or radiological disasters.

***Case Study:* Enhancing Preparedness to deal with the Humanitarian Consequences of a Nuclear Accident**

Following the severe earthquake and tsunami that triggered a nuclear accident in March 2011 in Japan, the Red Cross Red Crescent National Societies (NSs) adopted a resolution on preparedness to respond to the humanitarian consequences of nuclear accidents. The objective of this resolution is to improve the knowledge and competence of IFRC and the NSs in order to play a greater role in preparedness and response efforts for nuclear and radiological emergencies, as well as to reinforce the capacity to cope with humanitarian consequences during and after a nuclear accident.



For this purpose, the IFRC and Japanese Red Cross have prepared a range of information materials, based on NSs testimonials and documentation, to provide interested stakeholders with knowledge on the challenges faced by its staff and volunteers in various nuclear disasters. These materials are made available to the public and interested organizations through the Red Cross Nuclear Disaster Resource centre – Digital Archive. http://ndrc.jrc.or.jp/?lang=en

The International Red Cross Red Crescent Movement has a history of responding to nuclear and radiological emergencies. IFRC and National Societies can draw on the lessons learned from the response to the accidents at the Three Mile Island NPP in the USA, the Chernobyl NPP and the Fukushima Daiichi NPP. In order to deliver the most urgent humanitarian relief and to accompany communities on the road to recovery, very specific knowledge and equipment are required. Drawing from the experiences of Red Cross volunteers and staff who worked alongside affected communities, even as they faced challenges to their own safety and health, a set of operational guidelines have been developed. The aim of these guidelines is to help humanitarian actors to think through the various scenarios they may have to deal with should they face a nuclear or radiological emergency.

See: http://www.ifrc.org/Global/Documents/Secretariat/201602/1296000-NuclearRadio.Emer.Guide-Int-EN-LR.pdf

C. Enhancing preparedness and building back better: The case of transport hazards

Improving preparedness and response to transport accidents involves the engagement of multiple actors, including state and local transport authorities, land-use planners and railway managers. The response to a transport accident could also include international organizations, specialized agencies and technical experts. Engaging in open communication, and encouraging flexibility among integration of emergency response and contingency planning efforts, will make national and global response capabilities most effective.

Key Considerations and activities related to enhancing preparedness for transport accidents and building back better include, but are not limited to, the following:

- Encouraging adoption of national and local standards and industry best practices (i.e., hazardous material transport technology, emergency preparedness plans);
- Ensuring that an integrated and coordinated emergency management system for emergency warning and communication related to a transport accident is established and properly maintained;
- Increasing awareness of emergency procedures in case of an accident involving dangerous goods, such as:
    - for maritime transport: the “IMO Emergency Procedures for Ships carrying dangerous goods”
    - for air transport: the “ICAO Emergency Response Guidance for aircraft accidents involving dangerous goods”
    - for inland transport, different systems developed nationally or regionally, some of which are very well known and applied in many countries
    - In America, the “Emergency Response Guidebook”; in Europe: the “BIG emergency response system”[61] and the CEFIC ERICARDS;[62] In Australia/New Zealand,[63] the HAZCHEM system used in UK, Australia, New Zealand, Malaysia and some other countries[64]

[61] https://www.big.be/en-us/
[62] http://www.ericards.net/
[63] https://law.resource.org/pub/nz/ibr/as-nzs.hb.76.2010.pdf
[64] http://the-ncec.com/assets/Resources/EAC-Dangerous-Goods-List-2013.pdf

- Promoting resilience through the consideration of communities, public facilities and infrastructure within range of risk when developing new transport, or during a post-disaster reconstruction process, and ensure consultation with people affected;
- Improving capacity for preparedness and response by ensuring that roles and responsibilities to transport accidents are clearly specified and assigned based on a multi-hazard assessment and graded approach;
- Training workforce and voluntary workers in disaster response related to transport accidents, including transport-specific issues (e.g., fatigue, use of navigation equipment and emergency response procedures), and strengthening logistical capacities to ensure better response during an emergency; and
- Promoting cooperation among multiple transport and land-use authorities and organizations, and engaging in training and/or information-sharing exercises.

***Case Study:* Joint Training on Chemical Emergencies for Emergency Managers and Hazardous Waste Focal Points**

In October 2016, the UN Environment/OCHA Joint Unit (JEU) and the Basel, Stockholm and Rotterdam (BRS) Conventions Secretariat renewed their existing interface agreement, signed in 2011, between JEU and the Basel Convention. The agreement covers the responsibilities in case of an accident involving the transboundary movement of hazardous waste, where the Convention Secretariat will use the services of the JEU to offer joint assistance to affected countries. This agreement is referred to in a number of Convention decisions, and a separate trust fund has been set up by Convention parties to cover costs of emergency assistance. The agreement also covers preparedness and forms the base of joint training activities. One such training took place in Sao Paulo, Brazil in February 2017.

The purpose of the joint training on hazardous waste and chemical emergencies was to provide information to BRS convention focal points and emergency managers on best practices for preventing, preparing, and responding to chemical emergencies. By having both emergency managers and BRS focal points at the training, they could jointly identify challenges and gaps related to the reduction of risks from hazardous waste transport. They identified options available for emergency assistance in case of an incident caused by the transboundary movement of hazardous and other wastes. Information on existing mechanisms and procedures put in place by international, regional and national organizations was also shared. Joint preparedness activities allow participating stakeholders to identify how to mainstream technical activities related into broader emergency preparedness and response strategies and plans and works to strengthen collaboration between the two domains.

See: http://www.un.org/depts/los/general_assembly/contributions_2015/BRS.pdf

PART 2: The Multi-Hazard Approach

The Sendai Framework emphasizes the importance of taking a "multi-hazard approach" to DRR. As such, it provides a major opportunity for the man-made hazards community to better integrate such hazards in the overall DRR agenda. In practical terms, and at all geographic levels, man-made hazards can and should be included in ongoing DRR activities. This has the added advantage of allowing disaster managers to benefit from resources, expertise and knowledge available within other communities and domains.

Key Considerations and activities for ensuring a multi-hazard approach include, but are not limited to, the following:

- Describing how to employ a multi-hazard approach to management of man-made disaster risk;
- Integrating man-made hazards in multi-hazard early warning systems and forecasting, as well as DRR preparedness, prevention, response and recovery exercises and plans;
- Promoting investments in innovation and technology development specifically for man-made hazards and multi-hazard research into disaster risk management;
- Promoting comprehensive surveys, educational and publicity campaigns, and awareness-raising on multi-hazard disaster risks that also include man-made hazards;
- Promoting training of local authorities responsible for emergency preparedness and response in countries or areas with identified natural or industrial hazards;[65]
- Using strategic environmental assessment combined with risk assessment as a means to consider, in a transparent and inclusive manner, multiple hazards and possible propagation of domino effects across space and time; *and*
- Conducting further research into how natural disasters can cause technological ("Natech") disasters (e.g., Fukushima) and promoting concrete steps to avoid such occurrences.

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[65] APELL Multi-Hazard Training Kit for Local Authorities (2010) http://eecentre.org/Modules/EECResources/UploadFile/Attachment/APELL_Multi-Hazard_training_kit_for_local_authorities.pdf

I. REDUCING THE RISK OF NATECH ACCIDENTS

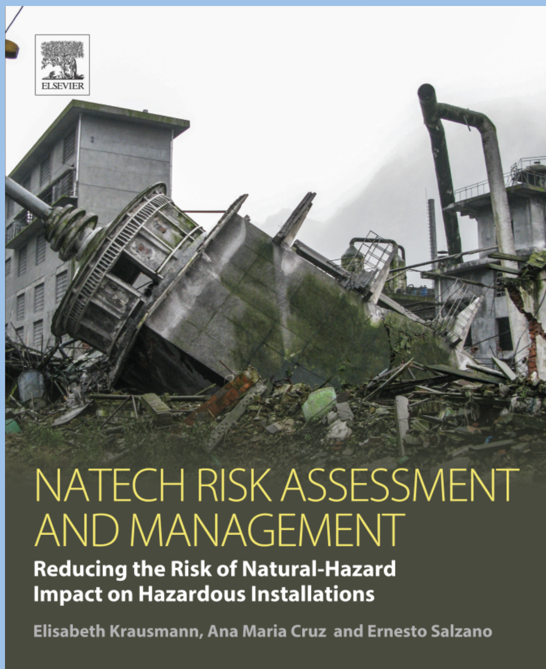
Natural hazards, such as earthquakes, floods, storms, or extreme temperatures etc., can cause the release of dangerous substances from hazardous installations resulting in fires, explosions or toxic or radioactive releases. These so-called Natech accidents are frequent in the wake of natural disasters and have often had severe and long-term consequences on the population, the environment and the economy.[66] Interestingly, any kind and size of natural hazard can trigger a Natech accident. It does not necessarily require a major natural hazard event, like a strong earthquake or a major hurricane, to cause a Natech accident. With increasing industrialisation and urbanisation coupled with climate change, Natech risk is expected to increase in the future.

***Key Considerations** and activities for reducing Natech risk include:*

- Understanding how Natech risk differs from conventional technological risk and engaging in dedicated training exercises for Natech emergency management;
- Promoting an integrated risk-governance approach to address the safety of individual hazardous installations but also their interaction with other installations, lifelines, and nearby communities in case of a natural event;
- Reassessing assumptions with regard to protecting hazardous installations from natural hazards, including recognition of design limits, in particular in the context of climate change;
- Understanding the potential for Natech accidents to develop into large-scale disasters, and awareness that Natech preparedness levels are low, even in generally well-prepared countries;
- Promoting the learning of lessons from past Natech accidents and their implementation to prevent future accidents, enhance preparedness levels, and build back better;
- Developing assessment tools and guidance for industry and government authorities to support better Natech risk management at national and local levels; and
- Encouraging cooperation among all stakeholders, and most importantly those at local level, in the design and implementation of preparedness planning for Natech disasters.

[66] Krausmann, E., Cruz, A.M., Salzano, E. (2017) Natech risk assessment and management – Reducing the risk of natural-hazard impact on hazardous installations, Elsevier, Amsterdam.

***Case Study:* Considering natural hazards in the German Technical Rules for Installation Safety**



Germany has issued two Technical Rules for Installation Safety (TRAS) that support the implementation of the German Major Accidents Ordinance (MAO) with a focus on reducing Natech risks. TRAS 310 addresses Natech hazards due to floods and precipitation, while TRAS 320 deals with hazards triggered by wind, snow and ice loads. Both TRAS follow an assessment approach that is based on methodologies already applied to operational hazards in the chemical industry. The TRAS outline the process to be followed by operators of hazardous installations in fulfillment of their obligations with respect to the MAO. They also define probabilities or intensities of the addressed natural hazards to be considered in the design and operation of chemical installations. TRAS 310 is unique in that it requires the application of a climate-adaptation factor (1.2) to the triggering natural-hazard intensities to take into account the expected effects of climate change in Germany in the period up to 2050. Chemical industry near the Rhine River has already invested in Natech risk reduction by implementing protection measures against a 500-year flood rather than only against the minimum flood severity required by law. This will protect industry from water intrusion and subsequent hazardous-substance releases but also from losses due to prolonged business interruption.

See: https://www.elsevier.com/books/natech-risk-assessment-and-management/krausmann/978-0-12-803807-9

II. OTHER KEY ISSUES/RECURRING THEMES OF RELEVANCE TO MAN MADE/TECHNOLOGICAL HAZARDS IN SENDAI FRAMEWORK FOR DRR

A. Collaboration, engagement and partnerships

Prevention, preparedness, response and recovery for man-made hazards are complex challenges that demand for the collaboration of all relevant stakeholders at all levels. Through the creation and maintenance of beneficial interactions, partnerships and networks of key players in the realm of hazard management, cooperation at local, regional and national levels can be facilitated. Partnerships and networks thus represent a powerful knowledge and capacity basis for successful man-made hazard risk management. Knowledge and capacity exchange, linkages and collaboration with other existing networks, such as the ones of the natural hazards community, should be strengthened to benefit from synergies and mutual learning.

The private sector has to be increasingly included in existing networks. While representing a powerful player in the field of hazard risk management with large capacities, it also has an incontestably important role with regard to sustainable business and industry development.

B. Multiple dimensions of disaster risk

Disaster risk is the product of an interplay between the physical hazard characteristics, the exposure of humans and assets to it as well as their vulnerabilities. The latter also includes capacities to cope with and adapt to occurring hazard events. Consequently, the materialization of man-made disaster risk can result in impacts on multiple dimensions, highlighting the importance of comprehensive disaster risk management. Key actors in the field of man-made hazard risk management need to be well informed about the multi-dimensional character of man-made hazards in order to conduct, among others, comprehensive pre-disaster risk assessments and preparedness activities tailored to prevent potential hazard impacts on different dimensions.

C. Data, GIS and remote sensing

Data, both statistical and geospatial, play an essential role in advancing all four of the Sendai Framework priorities. In better understanding risks from man-made hazards, data can help for example to document, enumerate and categorise various risk types and their impacts in terms of human victims, economic and environmental losses. Data are necessary for strengthened governance, both for drawing up improved legislation and related measures to prevent and prepare for man-made hazard events, for monitoring, and for improving future management of related risks. Investing in resilience also requires accurate data on which actions are most effective in mitigating man-made hazard events, so that financial and other resources can be properly targeted. Finally, geospatial and statistical data are indispensable for improving emergency preparedness and response measures, not only in terms of localising potential sites of man-made hazards, but also in making viable plans for coping with the same.

The utility in developing related Geographic Information System(s) (GIS) containing all or at least most of these elements cannot be underestimated, with both relevant statistical and geospatial data, including where possible up-to-date satellite imagery. Dynamic mapping and contingency planning based on the data and GIS software can be an invaluable resource for the relevant authorities. Use of GIS also supports land-use planning, as well as recognition of potential hazards and appropriate measures to eliminate those hazards.

D. Scientific methodologies; assessment and monitoring

The use of scientific methodologies, particularly for conducting assessments and carrying out regular monitoring of man-made hazards, is also valuable in terms of improved DRR and management. Contingency planning for accidents, Environmental Impact Assessments and use of Safety Performance Indicators (SPIs) are just three examples of approaches that can be applied to better understand risks, increase resilience and improve emergency preparedness and response measures. Modeling of potential man-made hazard events and their eventual impacts on surrounding communities and the physical environment can help to avoid or mitigate such impacts, by planning effective responses far in advance and thus increasing local resiliency, for example. Assessments can also be done on a regular basis within potentially dangerous facilities to improve safety and response measures, with major cost savings in terms of human, economic and other losses.

E. Innovation and technology

In order to meaningfully improve disaster risk management around the world, enhancing access and use of advanced technology and innovations is essential. Acknowledging that especially developing countries are often deprived from access to the advanced technologies and innovations. Therefore, enhanced knowledge transfer, exchange and technical assistance between developed and developing countries need to be facilitated and strengthened. In addition to improved access, investment need to be made for multi-hazard, solution-driven research, innovations and technologies, ensuring long-term disaster risk management approaches.

F. Communication, education and training

Man-made hazard risk needs to be understood by all stakeholder, from scholars, over politicians to the general public, as only widespread awareness and knowledge of the risk can help to prevent, prepare for, respond to and recover from hazard effects. Hence, awareness raising and education in the field of man-made hazards is of utmost importance. While media campaigns and targeted awareness raising strategies can highlight the importance of man-made hazard risk, tailored trainings can provide selected audiences with knowledge about causes, assessment methods and tools for specific hazards. Such efforts also strengthen preparedness and prevention efforts, facilitate mitigation efforts and work towards improving hazard risk management. Besides face-to-face trainings and workshops, online learning packages play an increasingly important role, as they are easily accessible for a wide range of actors from various backgrounds.

G. Man-made hazards and their environmental impact

Man-made hazards often have major negative impacts on the environment. Mainstreaming environmental aspects in all phases of disaster risk management; prevention, preparedness, response and recovery, is of utmost importance to achieve sustainable and effective disaster risk management. The UN Environment/OCHA Joint Unit[67] represents an example for how the coordinated collaboration between environmentalists and humanitarians in the field of man-made hazard preparedness and response can ensure the consideration of environmental aspects throughout the disaster management cycle, culminating in improved man-made hazard preparedness as well as in the duly consideration of environmental aspects in hazard risk management.

[67] http://www.unocha.org/what-we-do/coordination-tools/environmental-emergencies

***Case study:* The Environmental Emergencies Learning Centre**

The Environmental Emergencies Learning Centre is a platform developed by the UN Environment/OCHA Joint Unit that hosts a series of free online learning modules focusing on a variety of topics in the realm of environmental emergency preparedness and response. Due to the multi-hazard approach the platform targets environmental actors as well as disaster managers.

See: http://learning.eecentre.org/login/index.php

H. Extensive disaster risk

Extensive disaster risk is defined as “The risk of low-severity, high-frequency hazardous events and disasters, mainly but not exclusively associated with highly localized hazards.” [68]Extensive disaster risk is usually high where communities are exposed to, and vulnerable to, recurring localized floods, landslides, storms or drought. Extensive disaster risk is often exacerbated by poverty, urbanization and environmental degradation.

Similar to large-scale natural hazards, large man-made disasters often receive most attention with regard to the overall risk management but in particular regarding disaster response and recovery efforts. However, also low-severity, frequently occurring hazard events can culminate in severe impacts due to their cumulative character. For example, since the development of the oil industry in Nigeria, the country suffers frequent oil spills due to technical problems and sabotage. According to the local Department of Petroleum Resources about 4,647 incidents resulted in a spill of 2,369,470 barrels of oil into the environment between 1976 and 1996, successively harming mangrove forest and causing displacements and conflicts[69].

Extensive risk has to be carefully considered within the realm of man-made hazard management. Awareness raising for low-severity hazard events and their cumulative impacts as well as management strategies need to be integrated to comprehensively addressing man-made hazard risk.

[68] UNISDR terminology 2017 http://www.preventionweb.net/english/professional/terminology/v.php?id=7823

[69] Nwilo, P.C., Badejo, O.T. (2015): Impacts and Management of Oil Spill Pollution along the Nigerian Coastal Areas. Available online: http://www.fig.net/resources/publications/figpub/pub36/chapters/chapter_8.pdf

Summary

UNISDR, UN Environment and OCHA have partnered with several key agencies and institutions to develop this targeted WiA Guide, with the aim to strengthen national and local disaster risk management plans, by the inclusion of an all-hazards approach that covers man-made and technological hazards, and to raise awareness for better prevention, preparedness and response to the risks and impacts of these hazards. This Guide provides insights on man-made/technological hazards vis-a-vis the Sendai Framework's four priorities; namely, 1) understanding disaster risk; 2) strengthening disaster risk governance; 3) investing in disaster risk reduction for resilience; and 4) enhancing disaster preparedness for effective response and to "build back better" in recovery, rehabilitation and reconstruction.

The Guide highlights the enormous costs and multiple impacts of Man-made / Tech hazards in various domains, including those stemming from **chemical and industrial** accidents, **nuclear and radiological emergencies** as well as accidents in the **transport sector** and those associated with the particular case of **"Natech" hazards**.

Man-made / Tech disasters, whether caused by natural or man-made hazards, can cause severe damage to individuals, communities, economies, supply chains and the environment. Moreover, they may trigger secondary disasters, aggravating initial impacts. Industrial facilities, nuclear and other technological installations and transport systems are all vulnerable to natural hazards, and their design is not always adequate to withstand current or future impacts.

In purely economic terms, the cost of natural and man-made disasters worldwide has been estimated at US$ 175 billion for 2016 alone, with US$ 9 billion of that stemming from man-made disasters. This number has risen from previous years and continues to grow due to increasing disaster risk as a result of factors such as climate change, rapid urbanization and industrialization. In the case of one high-profile example, the Fukushima radiological emergency displaced 165,000 people and has an estimated economic recovery cost of US$ 235 billion. In another example, hundreds of hazardous materials were released after hurricanes Katrina and Rita, while pipeline accidents, train derailments and other transport accidents hauling dangerous goods have caused catastrophic pollution incidents around the world. Such examples illustrate the "business case" for improved preparedness and response to Man-made / Tech hazards, as well as the importance of implementing multi-sectoral and multi-hazard approaches to reducing risk from them.

This WiA Guide on Man-made / Tech Hazards offers a targeted set of practical activities for implementation at national and local levels. It also clarifies the roles and responsibilities of specialized stakeholders within each of the four Priorities for Action with regard to man-made hazards, and the subset of technological hazards.

A review of over-arching **key considerations** and prominent examples of "no-regrets" actions, *which apply across all four of the Man-made / Tech* mentioned above includes:

1) Understanding disaster risk:

- Conduct risk assessment and ensure access to pre-disaster risk assessment information, with a baseline for hazards, exposure, risks and vulnerability, including local sources of risks;
- Collect information on local institutions, capacities and plans to address disasters;

- Develop and regularly update local and national maps on disaster risk, hazards, human exposure and vulnerability, including key infrastructure elements;
- Engage with communities at risk to understand community structures and support inclusiveness, while ensuring access of communities to relevant risk information;
- Enhance understanding of disaster risks among all stakeholders, including government officials at all levels, civil society and NGOs, local communities, the private sector, disaster and emergency responders as well as volunteers;
- Improve the flow of disaster risk information from scientific and technical experts to policy-makers, communities and other stakeholders, and assure appropriate use of the same;
- Strengthen understanding of disaster risk at the local level through education and awareness-raising campaigns;
- Apply risk information to develop and implement DRR policies and strategies.

2) Strengthening disaster risk governance:
- Mainstream DRR within and across all sectors dealing with man-made hazards, through relevant legal frameworks, policies, regulations, reporting requirements and compliance incentives;
- Ensure that sectors involved in man-made risk management are involved in appropriate DRR coordination and organizational structures, including forums and platforms at local and national levels;
- Ensure that sectors involved in man-made risk management adopt and apply national and local DRR strategies and plans, including targets, indicators and timeframes, and follow-up mechanisms to monitor progress;
- Assign clear roles and tasks to relevant national and local authorities, community leaders and other stakeholders to operationalize strategies and plans, while reinforcing the role of the appropriate national authority(-ies) as having primary responsibility for DRR.

3) Investing in disaster risk reduction for resilience:
- Ensure the allocation of financial and logistical resources to implement DRR plans, policies and strategies at national and local levels;
- Promote disaster risk financial sharing, transfer and insurance mechanisms;
- Strengthen public and private sector investments to prevent and reduce the impacts of man-made disasters, including their impact on critical infrastructure;
- Improve building codes and standards and enforce specific standards in the construction of all technological facilities;
- Invest in appropriate land use, local planning and zoning policies in relation to the location of technological facilities;
- Enhance the resilience of national health care systems to deal with specific hazard types, and enhance local access to basic health care services and safety-nets for post-disaster assistance for populations at risk from man-made disasters;
- Protect the most disadvantaged persons, along with livelihoods and productive assets, including major earning sectors such as tourism, from man-made hazards.

4) Enhancing disaster preparedness for effective response and to "build back better" in recovery, rehabilitation and reconstruction:
- Develop and update disaster preparedness and contingency plans, programs and policies at regional, national and local levels, involving relevant authorities and stakeholders in a "whole of government, whole of society" approach;

- Develop and maintain multi-sectoral rapid early warning and alert systems including robust means of communication to inform the public prior to and during an incident to prevent and/or mitigate the impacts and facilitate the response;
- Develop and enforce improved building codes and standards for the (re-) construction of all technological facilities for preventing future Man-made / Tech disasters;
- Promote the resilience of key infrastructure such as power, water, emergency centers, roads and water treatment plants, that are critical in preparing for and responding to man- made disasters;
- Conduct targeted training for emergency workers e.g. first responders, medical staff, public service and voluntary workers who deal with specific man-made disasters;
- Organize and conduct periodic disaster preparedness, response and recovery exercises and evacuation drills, with the involvement of the public;
- Promote cooperation among multiple authorities, relevant institutions and stakeholder groups to assure a smooth and effective Man-made / Tech disaster response.

In summary, putting in place as many as possible of the measures listed above will help any government to be both better prepared for a possible Man-made / Tech emergency event, and to mitigate the potential impacts of such an event on people, society, the economy and the environment, while addressing the four priorities of the Sendai Framework.

Final Take-away Messages

Governments are increasingly recognizing the critical role of risk reduction in relation to Man-made / Tech hazards, initiating the integration of improved mitigation and preparedness measures. Among other progress, this development has facilitated the adoption of innovative technologies, the development of educational programs and awareness-raising campaigns, as well as the implementation of structural and non-structural methods to protect at-risk populations and physical assets. Despite this, Man-made / Tech hazards are still occurring and will continue to occur around the world. Many of these happen widely unnoticed, causing varying degrees of harm to the environment as well as individuals, with highly vulnerable groups suffering the most severe effects. In addition, Man-made / Tech accidents take a heavy toll on affected economies as they cause high financial losses, sometimes with long-term impacts on economic structures. In order to reduce the prevalent risk, political leadership is needed to facilitate the development of policies and frameworks for disaster preparedness for and response to Man-made / Tech hazards. Political will can also help to integrate this topic into existing national and local disaster risk reduction and management strategies and plans.

This WiA Guide on Man-made / Tech Hazards has reviewed the diverse institutional and legal mechanisms, thematic frameworks, financial considerations and potential collaborations and partnerships available to support country and local-level implementation of DRR measures. In order to make meaningful progress in disaster risk management in relation to Man-made / Tech hazards, it is essential to fully understand the risks stemming from these particular hazards. Therefore, further research efforts and an integrated multi-hazard approach need to be taken. In addition, the involvement and accountability of all relevant stakeholders in managing disaster risk caused by man-made hazards are important for successful risk governance on all levels. Governance also requires increased financial investments in risk reduction and mitigation strategies, as well as in preparedness efforts.

In conclusion, the successful reduction of disaster risk emerging from Man-made / Tech hazards can only be achieved when the risk is comprehensively understood, acknowledged and addressed through a multi-hazard, multi-stakeholder and *fully integrated* approach. Moreover, stakeholders need to be equipped with sufficient financial means to advance targeted risk reduction, mitigation and preparedness policies and actions.

Finally, learning from past Man-made / Tech hazards and investing in and applying these "lessons learnt" is key to avoid and mitigate future impacts of Man-made / Tech hazards.

Annex

This section provides a listing of key documents, major entities and initiatives that can be used as further, more detailed entry points to man-made hazards, along with preparedness for, prevention of and response to same. Where possible, URL addresses are included to facilitate access by man-made hazard community practitioners. It also provides links to existing communities and networks of man-made hazard groups.

I. KEY DOCUMENTS FOR MAN-MADE / TECH HAZARDS

Alternative Classification Schemes for Man-Made Hazards in the Context of the Implementation of the Sendai Framework, working paper, the UNISDR and Open-ended Intergovernmental Expert Working Group on Indicators and Terminology
Relating to Disaster Risk Reduction, 5 June 2016, 21 pages.

An overview of methodologies for hazard rating of industrial sites, European Commission Joint Research Centre and UNECE, Ispra and Geneva, 2016, 76 pages.
www.unece.org/index.php?id=41786

APELL Multi-Hazard Training Kit for Local Authorities for community vulnerability reduction, prevention, and preparedness; UNEP/DTIE, Paris, 2010, 50 pages.

Assessment and Proposals for Uranium Production Legacy Sites in Central Asia: an International Approach; Report compiled in two meetings of technical experts, IAEA Division of Radiation, Transport and Waste Safety, Vienna, 2010(?), 163 pages.

Checklist for contingency planning for accidents affecting transboundary waters, UNECE, UN symbol ECE/TEIA.CP/34, New York and Geneva, 2016, 51 pages.
www.unece.org/index.php?id=44290

Corporate Governance for Process Safety: OECD Guidance for Senior Leaders in High Hazard Industries; OECD Environment, Health and Safety; Chemicals Accidents Programme; June 2012, 20 pages. ==> https://www.oecd.org/env/ehs/chemical-accidents/corporategovernanceforprocesssafety.htm

Directive 2008/96/EC of the European Parliament and of the Council of 19 November 2008 **on Road Infrastructure Safety Management**, as published in the Official Journal
of the European Union, volume L319/59-67, 29 November 2008, nine pages.

EMSA's Best Practice Guidance on the Inventory of Hazardous Materials (IHM), European Marine Safety Agency (EMSA), Lisbon, October 2016, 40 pages.
http://www.emsa.europa.eu/news-a-press-centre/external-news/item/2874-emsa-s-best-practice-guidance-on-the-inventory-of-hazardous-materials.html

Environmental Emergency Preparedness: Industrial Accidents in Toamasina, Madagascar. Final Report from the Scoping Mission of the UNEP/OCHA Environment Unit and the European Union Civil Protection Mechanism. UNEP/OCHA JEU, Geneva, 2013, 30 pages.

Environmental Exposure Assessment Strategies for Existing Industrial Chemicals in OECD Member Countries, OECD Series on Testing and Assessment, Number 17, ENV/JM/MONO(99)10, OECD, April 1999, 31 pages.
www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&cote=env/jm/mono(99)10

European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR 2017), UNECE, September 2016, Volume I and II, 1282 pages.
www.unece.org/trans/danger/publi/adr/adr_e.html *and*
http://www.unece.org/index.php?id=43866

European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN 2017), UNECE, September 2016, Volume I and II, 1024 pages.
http://www.unece.org/trans/danger/publi/adn/adn_e.html *and*
http://www.unece.org/index.php?id=45005

Flexible Framework for Addressing Chemical Accident Prevention and Preparedness: a Guidance Document, UNEP/DTIE/Sustainable Consumption and Production (SCP) Branch, 2010, 180 pages.
www.unep.org/resourceefficiency/Portals/24147/Safer%20Production%20(Web%20uploads)/UN_Flexible_Framework_WEB_FINAL.pdf

Guidelines for Rapid Environmental Impact Assessment in Disasters, Benfield Hazard Research Centre, University College London and CARE International, version 4.4, April 2005, 99 pages.

Guiding Principles for the Development of the UN Model Regulations, United Nations Economic and Social Council, Committee of Experts on the Transport of Dangerous Goods, 2015, 41 pages.
http://www.unece.org/trans/danger/publi/unrec/guidingprinciples/guidingprinciplesrev15_e.html

IMO: What it is / OMI Ce qu'elle est / OMI Qué es, International Maritime Organization, London, October 2013, 74 pages (in English, French and Spanish; separately in Arabic).
http://www.imo.org/en/About/Documents/What%20it%20is%20Oct%202013_Web.pdf

Introduction to Industrial Accidents (on-line training course in Chinese, English, French and Russian), UNECE, the Joint UNEP/OCHA Environment Unit and UNEP, Geneva, 2013.
www.unece.org/index.php?id=32240

IOMC Toolbox, Scheme on Chemical Accidents; Major Hazard Prevention, Preparedness and Response. http://iomctoolbox.oecd.org/default.aspx?idExec=fa0a7540-917a-4cd2-b316-c1454399e6f5

Joint Radiation Emergency Management Plan of International Organizations, Incident and Emergency Centre, Department of Nuclear Safety and Security, IAEA, Vienna, 2017, 151 pages.

Natech risk assessment and management - Reducing the risk of natural-hazard impact on hazardous installations, E. Krausmann, A.M. Cruz and E. Salzano, Elsevier Press, Amsterdam, 2017.

Natural disasters in the United States as release agents of oil, chemical, or radiological materials between 1980-1989: analysis and recommendations, P.S. Showalter and M.F. Myers in Risk Analysis, Vol. 14, no. 2, 169, 1994.

Nuclear and Radiation Studies Board, Lessons learned from the Fukushima nuclear accident for improving safety of U.S. nuclear plants. National Academies Press (US), Washington DC, October 2014. https://www.ncbi.nlm.nih.gov/books/NBK253939/

Objective and Essential Elements of a State's Nuclear Security Regime, IAEA Nuclear Security Series no. 20, IAEA, Vienna, Austria, February 2013, 32 pages.
www-pub.iaea.org/MTCD/Publications/PDF/Pub1590_web.pdf

***OECD Guiding Principles for Chemical Accident Prevention, Preparedness and Response:** guidance for industry (including management and labour), public authorities, communities and other stakeholders, OECD, 2003, 209 pages plus 29-page annex.
http://www.oecd.org/env/ehs/chemical-accidents/Guiding-principles-chemical-accident.pdf

OECD (2015) Natech Addendum to the OECD Guiding Principles for chemical accident prevention, preparedness and response (2nd ed.), OECD, Paris, see
http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2015)1&doclanguage=en

OECD (2013), Corporate Governance for Process Safety: Guidance for Senior Leaders in high Hazard Industry, OECD, Paris, https://www.oecd.org/chemicalsafety/chemical-accidents/corporate%20governance%20for%20process%20safety-colour%20cover.pdf

OECD (2003), Guidance on Safety Performance Indicators for Industry, OECD, Paris, see
https://www.oecd.org/chemicalsafety/chemical-accidents/41269710.pdf

OECD (2003), Guidance on Safety Performance Indicators for Public Authorities and Communities, OECD, Paris, see https://www.oecd.org/chemicalsafety/chemical-accidents/41269639.pdf

* - All publications of the OECD Chemical Accidents Programme are available at the following website: http://www.oecd.org/env/ehs/chemical-accidents/

Overview of Methodologies for Hazard Rating of Industrial Sites, the
Joint Research Centre (JRC) of the European Community and UNECE, Nov. 2015, 82 pages.
www.unece.org/index.php?id=41786

Preparedness and Response for a Nuclear or Radiological Emergency, General Safety Requirements, IAEA Safety Standards Series no. GSR Part 7, Vienna, 2015, 102 pages.

Recommendations on the Transport of Dangerous Goods, Model Regulations, 19th revised edition, United Nations Publication (New York and Geneva), 2015, Volume I and II, 862 pages.
full version as published by UNECE: www.unece.org/fileadmin/DAM/trans/danger/publi/unrec/rev17/English/Rev17_Volume1.pdf

Regulation concerning the International Carriage of Dangerous Goods by Rail (RID)
RID 2017, Intergovernmental Organisation for International Carriage by Rail (OTIF)
http://otif.org/en/?page_id=744

Safety guidelines and good industry practices for oil terminals, UNECE, UN symbol ECE/CP.TEIA/28, New York and Geneva, 2015, 65 pages.
www.unece.org/index.php?id=41066

Safety guidelines and good industry practices for pipelines, UNECE, UN symbol ECE/CP.TEIA/27, New York and Geneva, 2014/2015, 22 pages.
www.unece.org/index.php?id=41068

Safety guidelines and good industry practices for tailings management facilities, UNECE, UN symbol ECE/CP.TEIA/26, 2014, 34 pages.
www.unece.org/index.php?id=36132

Sendai Framework for Disaster Risk Reduction (DRR) 2015-2030, from the Third UN World Conference, Sendai held in Sendai, Japan, March 2015, as published by the UN Office for Disaster Risk Reduction (UNISDR), 32 pages.
http://www.unisdr.org/we/inform/publications/43291

Terminology related to Disaster Risk Reduction (an updated technical non-paper), Open-ended Intergovernmental Expert Working Group on Indicators and Terminology Related to Disaster Risk Reduction (OIEWG) and UNISDR, Nov? 2016, 42 pages.
http://www.preventionweb.net/drr-framework/open-ended-working-group/

25 Years of Chemical Accident Prevention at OECD: History and Outlook (brochure), Organisation for Economic Cooperation and Development (OECD), 2013, 46 pages.
https://www.oecd.org/chemicalsafety/chemical-accidents/Chemical-Accidents-25years.pdf

Updated technical non-paper on indicators for global targets A, B, C, D, E and G of the Sendai Framework for Disaster Risk Reduction, UNISDR, September 2016, 45 pages.

UNISDR DRR Terminology. 2017.
http://www.preventionweb.net/english/professional/terminology/

The UNISDR 2009 terminology
http://www.preventionweb.net/publications/view/7817

UNISDR Words into Action Guide on national and local platforms- Interim

http://www.preventionweb.net/publications/view/53055

UNISDR Words into Action Guide on Build back better in recovery- Interim
http://www.preventionweb.net/publications/view/53213

UNISDR Words into Action Guide on National risk assessment- Interim
http://www.preventionweb.net/publications/view/52828

UNISDR Words into Action Guide on Preparedness for effective response- Interim
http://www.preventionweb.net/publications/view/53347

UNISDR Words into Action Guide on Preparedness for effective response- Interim (addendum simulation exercises) http://www.preventionweb.net/publications/view/53348

Work of the Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals (report of the Secretary-General), UN ECOSOC, E/2017/53, 2017.

II. EXISTING KEY COMMUNITIES/NETWORKS OF MAN-MADE / TECH HAZARDS GROUPS

Awareness and Preparedness for Emergencies at Local Level (APELL)
www.unep.org/apell

Flexible Framework for Addressing Chemical Accident Prevention and Preparedness (CAPP)
www.unep.org/flexibleframework

Inter-Agency Coordination Meetings on Industrial Accidents
Members include UNEP and SAICM, UNECE, UNISDR, WHO, the European Commission, OECD and the Joint UNEP/OCHA Environment Unit.

Red Cross Nuclear Disaster Resource Centre / Digital Archive
http://ndrc.jrc.or.jp/?lang=en Environmental Emergencies Centre
www.eecentre.org

III. OTHER RELEVANT WEBSITES OF NOTE:

European Commission Science and Knowledge Service
https://ec.europa.eu/jrc/en/research-topic/reference-materials-nuclear-safeguards-safety-and-security

European Maritime Safety Agency (EMSA): www.emsa.europa.eu

European Process Safety Centre (EPSC): www.epsc.org

EU Directive on Road Infrastructure Safety Management:
eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32008L0096

Inter-Organisation Programme for the Sound Management of Chemicals (IOMC): www.who.int/iomc/en/

Intergovernmental Forum on Chemical Safety (IFCS): www.who.int/ifcs/en/

International Atomic Energy Agency (IAEA): www.iaea.org
IAEA Safety Standards Series
http://www-pub.iaea.org/books/IAEABooks/Series/33/Safety-Standards-Series
IAEA Resources in Emergency Preparedness and Response
https://www.iaea.org/newscenter/focus/fukushima/emergency-preparedness
IAEA: Nuclear Security Series publications
www-ns.iaea.org/security/nss-publications.asp?s=5&l=35#s
IAEA Report on Fukushima Daiichi accident, Report by the Director General
http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1710-ReportByTheDG-Web.pdf
IAEA, The International Chernobyl project, Technical Report
http://www-pub.iaea.org/MTCD/publications/PDF/Pub885e_web.pdf

International Federation of Red Cross and Red Crescent Societies (IFRC): http://www.ifrc.org
Nuclear and Radiological Emergency Guidelines (Preparedness, Response and Recovery)
http://www.ifrc.org/Global/Documents/Secretariat/201602/1296000-NuclearRadio.Emer.Guide-Int-EN-LR.pdf
Chernobyl Humanitarian Assistance and Rehabilitation Programme (CHARP)
http://www.ifrc.org/en/publications-and-reports/evaluations/?c=&co=&fy=&mo=&mr=1&or=&r=&ti=charp&ty=&tyr=&z=

International Maritime Organization: www.imo.org

(to list: at least five pollution-related conventions?)

www.imo.org/en/About/Conventions/ListOfConventions/Pages/Default.aspx

- International Convention on Oil Pollution, Preparedness, Response and Co-operation, 1990 (OPRC)
- Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances, 2000 (OPRC-HNS Protocol)
- Convention for the Prevention of Pollution from Ships, 1973, as modified by the 1978 and 1997 Protocols (MARPOL)
- International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea, 1996 as revised by the Protocol of 2010 to the Convention (2010 HNS Convention)
- International Convention on Civil Liability for Bunker Oil Pollution Damage (Bunker Convention)

OECD Programme on Chemical Accidents (PCA): Chemical Accident Prevention, Preparedness and Response: www.oecd.org/env/ehs/chemical-accidents

Seveso Directive on Industrial Accidents: ec.europa.eu/environment/seveso/

Strategic Approach to International Chemicals Management (SAICM):
www.saicm.org

UNECE Industrial Accidents Convention: www.unece.org/env/teia.html

UNECE Industrial Accident Notification (IAN) System:
www.unece.org/env/teia/pointsofcontact.html

UNECE Sustainable Transport Division (Transport of Dangerous Goods)
http://www.unece.org/trans/danger/danger.html

UN Environment/OCHA Joint Unit (JEU): www.unocha.org/unep

UNISDR -Words into Action Initiative
http://www.preventionweb.net/drr-framework/sendai-framework/wordsintoaction/

UNISDR Global Assessment Report
http://www.preventionweb.net/english/hyogo/gar/

UNISDR - Fact sheet: Health in the context of the Sendai framework for disaster Risk Reduction
https://www.unisdr.org/we/inform/publications/46621

UNISDR- International conference on the implementation of the health aspects of the Sendai Framework for DRR
http://www.unisdr.org/conferences/2016/health

UNISDR- Bangkok Principles for the implementation of the health aspects of the Sendai Framework for Disaster Risk Reduction 2015-2030
http://www.preventionweb.net/files/47606_bangkokprinciplesfortheimplementati.pdf

UNISDR- Understanding Risk http://www.preventionweb.net/risk

WHO on Environmental Health: www.who.int/topics/environmental_health

WHO Environmental Health "Fact Sheets":
www.who.int/topics/environmental_health/factsheets/en/

WHO's International Health Regulations: www.who.int/topics/international_health_regulations/en

WHO Radiation Emergency
http://www.who.int/ionizing_radiation/a_e/en/

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This guide is an effort from the international DRR Community and brokered by UNISDR