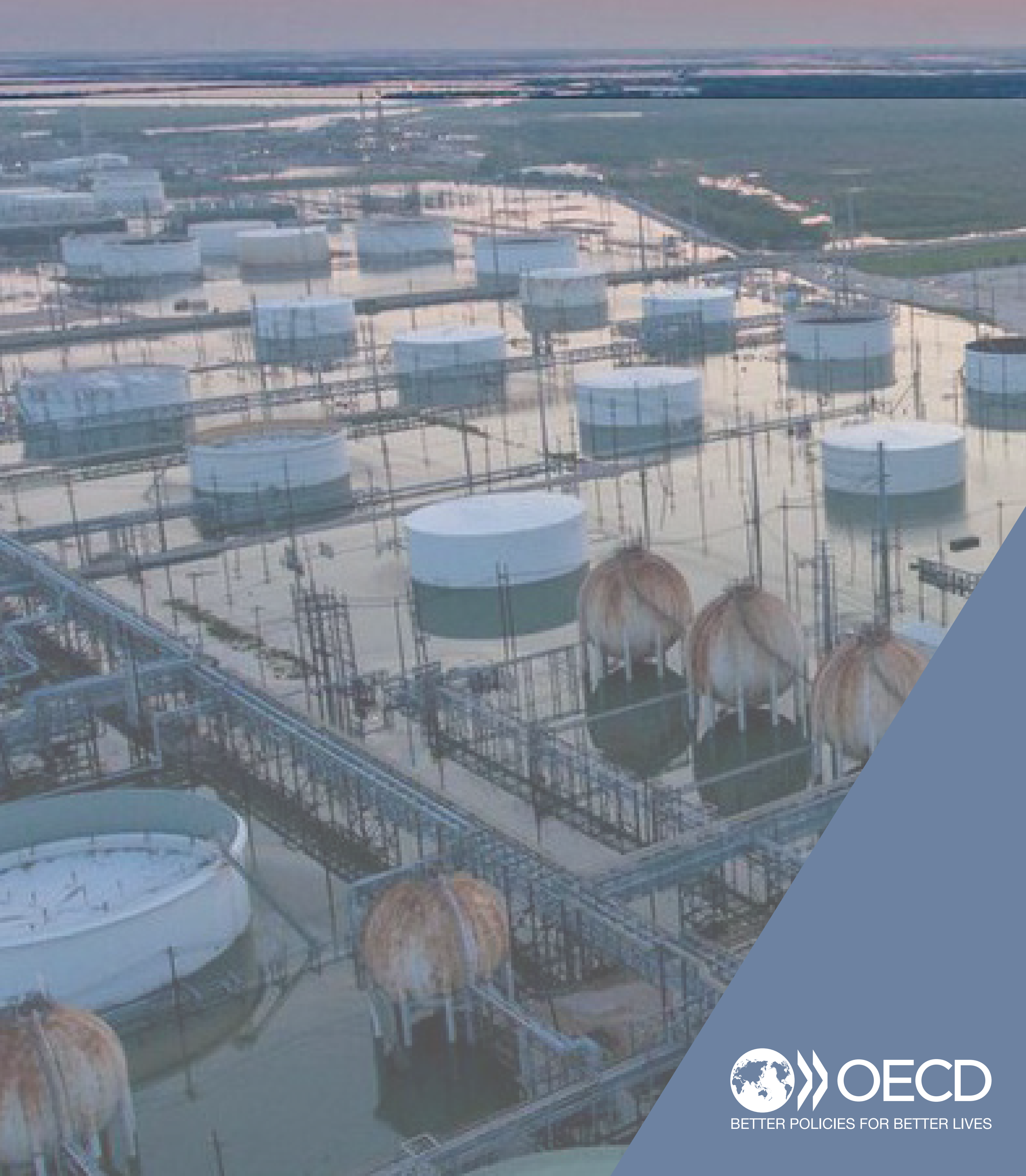
The Impact of Natural Hazards on Hazardous Installations



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Natural hazards, such as earthquakes, floods or storms, can initiate events which may challenge the safety and operation of hazardous installations and trigger an accident. These accidents are referred to as Natural hazard triggered Technological accidents - Natech.

This brochure aims to raise awareness of Natech risks and the challenges associated with their management. Using examples, it highlights key characteristics of Natech accidents, and gaps and challenges in analysing and managing Natech risks. It also describes the work and resources of some international organisations to support improved understanding of and resilience to Natech.

The brochure is intended for a broad and multidisciplinary audience, including industry, public authorities and practitioners involved in industrial safety and civil protection. It is also intended for the disaster risk management community as often Natech accidents are treated within the broader context of disaster management.

This work forms part of a wider OECD Programme on Chemical Accidents. The programme aims to share experience and recommend appropriate policy options for enhancing the prevention of, preparedness for, and response to, chemical accidents. It provides a forum for cooperation to help countries face common problems, learning from each other's experiences and raising the level of risk governance. The programme provides guidance and analyses emerging risks.

This brochure was developed by a steering group composed of the delegations of Czech Republic, France, Germany (lead country), Japan, Netherlands, Norway, Switzerland, United Kingdom, the United States, the Joint Research Centre of the European Commission (JRC), the United Nations Environment Programme (UNEP) / UN Office for the Coordination of Humanitarian Affairs (OCHA) Joint Environment Unit, the United Nations Economic Commission for Europe (UNECE), and the European Environmental Bureau (EEB).

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Contents

1 What is 'Natech'?

A "Natech" is an accident triggered by the impact of a natural hazard, such as earthquake, flood, or storm, on a hazardous installation, and which involves the release of hazardous substances, fires or explosions. Most of the installations that process, store or handle hazardous substances can in principle be vulnerable to the impact of natural hazards.

Many past natural disasters have caused major damage to installations resulting in loss of lives, health effects, environmental pollution, and economic losses.

Data and projections show that the frequency and intensity of natural hazards linked to climate change will increase in the decades to come; and some of them may occur at locations where they have never been observed before. Coupled with a growing human expansion (industrialisation, urbanisation), integration of climate change risks and uncertainties into Natech risk management is essential to the prevention, preparedness and response to Natech accidents.

2 The causes and consequences of Natech accidents

The collection and analysis of data from past Natech accidents[1] have shown that lightning, flood and low temperature are the three most common triggers of Natech events.

- **Lightning** is a significant hazard to installations. Damage or equipment failure can be triggered by direct impact from the lightning strike, or indirectly through impacts on the power grid or electrically operated control and safety systems (see the Milford Haven accident). Fires and explosions are the most frequent outcomes of lightning impact on storage tanks (see the Feyzin accident).

Milford Haven, United Kingdom, 1994 (lightning)

On 24 July 1994, an electrical storm caused disruption to power supply and a loss of process control at a large refinery near Milford Haven. A release of flammable material caused a fire initiated by a lightning strike and partial shutdown in one area of the refinery. Ongoing process control disruption to the wider operations on site led to a further release of about 20 tonnes of flammable hydrocarbons which ignited resulting in a massive explosion, injuring 26 people.

The root cause analysis of the explosion led to recommendations covering multiple areas of managing major hazard sites. Some linked to natural hazard initiating events, and others related to the initial loss of control including the use of management systems and emergency response.

Source: HSE (1997), *The explosion and fires at the Texaco Refinery, Milford Haven, 24 July 1994: A report of the investigation by the Health and Safety Executive*, HSE, https://www.hse.gov.uk/comah/sragtech/casetexaco94.htm.

Feyzin, France, 2011 (lightning)

On 17 September 2011, during a thunderstorm over Feyzin, lightning hit a refinery in two places, on a flare and on a tank. The tank of 2,000 m^3 was collecting process water, which contained hydrocarbons. Following the lightning strike, ignition occurred at one or more tank vents, eventually leading to an explosion and tank fire.

The tank did not have a retention basin. Firefighting foams reached the Rhône canal via the rainwater network.

Source: ARIA Database, N° 40953, see: https://www.aria.developpement-durable.gouv.fr/fiche_detaillee/40953/

[1] Krausmann, E. and E. Salzano (2017), "Lessons learned from Natech events", in: *Natech risk assessment and management – Reducing the risk of natural hazard impact on hazardous installations*, Elsevier, Amsterdam.

- **Floods** can impact specific equipment in an installation but also entire chemical facilities. They can cause:

- Flotation of equipment and damage to connected parts or equipment (see the Neratovice accident)
- Floating equipment or debris dragged along with the floodwaters and damaging sensitive equipment on site via collision;
- Tanks to collapse or implode if the force of the floodwater is strong enough;
- Short circuits and power failure when water comes into contact with electrical equipment (see the Crosby accident);
- Effects on large areas carrying hazardous substances over great distances;
- Toxic or flammable vapours from released chemicals that react violently with water.

Neratovice, Czech Republic, 2002 (flood)

On 15 August 2002, a large flood occurred and inundated the premises of a chemical plant in Neratovice. The plant had liquid chlorine tanks (an acute toxic, irritating, pressuried gas, very toxic for water species). A building containing five tanks was flooded with a level of water exceeding by 1.3 m the maximum level of the 100-year flood. Some of the tanks were displaced from their normal positions resulting in a massive leakage of chlorine (about 80 tons). Fortunately, most of the chlorine was dissolved in the water and the surroundings of the facility had already been evacuated because of the flooding. There were not any direct injuries but damages to the environment.

Source: eMARS (15.08.2002)

Baia Mare, Romania, 2000 (heavy rain, snowmelt, transboundary effects)

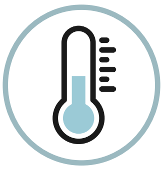
On 30 January 2000, following a breach in the tailing dam of a mining company, a major spill of cyanide-rich tailings waste was released into the river system near Baia Mare in north west Romania. A tailings pond was breached due to heavy rain, unexpected levels of snowmelt increased water levels in the pond, and exposed design deficiencies. This accident caused widespread transboundary water pollution in the Danube River, through Romania into Hungary, Serbia and Bulgaria, finally entering the Black Sea.

Source: UNEP/OCHA (2000), *Cyanide spill at Baia Mare Romania*, see https://reliefweb.int/report/romania/cyanide-spill-baia-mare-romania-unepocha-assessment-mission-advance-copy.

Crosby, Texas, United States, 2017 (flood)

On 24 August 2017, Hurricane Harvey, a Category 4 hurricane, hit southeast Texas. Over the next days, the storm produced unprecedented amounts of rainfall over southeast Texas and southwest Louisiana, causing significant flooding. A facility at Crosby, which handled organic peroxides, was located within the 100-year and 500-year flood plains. Rainfall exceeded the equipment design elevations and caused the plant to lose power, backup power, and critical organic peroxide refrigeration systems.
On 31 August 2017, organic peroxide products stored inside the refrigerated trailer decomposed, causing the peroxides and the trailer to burn.
Twenty-one people sought medical attention from exposure to fumes generated by the decomposing products when the vapor travelled across a public highway adjacent to the plant. Over the course of three fires, in excess of 350,000 pounds of organic peroxide combusted. As a result, more than 200 residents living within 1.5 miles of the facility who had evacuated the area could not return home for a week.

Source: CSB (2018), 'Organic Peroxide Decomposition, Release, and Fire at Arkema Crosby Following Hurricane Harvey Flooding - August 31, 2017, Crosby, Texas; U.S.', *Chemical Safety and Hazard Investigation Board, Investigation Report Number: 2017-08-I-TX*; Washington, DC, https://www.csb.gov/arkema-inc-chemical-plant-fire-/



- **Low temperature** is a frequent cause of accidents, and its risk is severely underestimated as an accident initiator (see the Kolin accident). For example, freezing of hazardous substances can cause the blocking of pipes and valves; after freezing and thawing the properties of some substances may also change.

Kolin, Czech Republic, 2011 (low temperature, accident with transboundary effects)

On 9 January 2006, about 0,2 tons of cyanide were released from a detoxification sump at a chemical factory in Kolin. One of the accident causes was the failure of a floating alarm device controlling the maximum level of wastewater in the sump. Temperatures had fallen from 13°C to minus 15°C in the night, causing a freezing of the device, which had no resilient measurement technology or heating system. The cyanide contained in the wastewater went in the River Labe (Elbe) causing an increase in cyanide concentration on the river up to Germany and the death of fish.

Source: eMARS (09.01.2006)

- Other natural hazards have caused Natech accidents. For instance, loss-of-containment during **earthquakes** is very common and flammable releases are likely to ignite, often causing high-severity accidents. Damage to installations is caused by direct shaking or ground deformation (see the Chiba accident).

Chiba, Japan,2011 (earthquake)

On 11 March 2011, the Magnitude 9 Great East Japan earthquake triggered multiple fires and explosions at the Liquefied Petroleum Gas (LPG) storage tank farm of a refinery in Tokyo Bay. At least 5 explosions occurred, the biggest of which created a fireball of about 600 m in diameter. Missiles from the exploding LPG tanks damaged asphalt tanks located next to the storage area, leading to asphalt leakage into the ocean. The accident also caused other effects when debris impact and LPG dispersion triggered fires in two neighbouring petrochemical installations. The fires burned for 10 days.

At the refinery, six people were injured, while three injuries were reported in the facility adjacent to the LPG tank farm. Overall, 1,142 residents in the vicinity of the industrial park had to be evacuated. Onsite, all 17 LPG tanks were destroyed and the refinery returned to full operation only 2 years after the accident.

Sources:
Krausmann, E. and A.M. Cruz (2013), Impact of the 11 March 2011, Great East Japan earthquake and tsunami on the chemical industry, Natural Hazards, vol. 67, p.811
Cosmo Oil (2011), Overview of the fires and explosion at Chiba refinery, the cause of the accident and the action plan to prevent recurrence, Press Release August 2, 2011, http://www.cosmo-oil.co.jp/eng/press/110802/index.html.

Even "common" natural hazards, such as lightning, cold and low temperatures can cause major Natech accidents.

3 What makes the management of Natech risk so special?

Measures for accident prevention, preparedness and response need to take account of the specific characteristics of Natech risk.

The management of Natech risk is complex due to specific characteristics. For example:

- The prevention and management of Natech risks require a multi-disciplinary approach and cooperation - experts on natural hazards such as meteorologists, hydrologists, geologists need to work alongside civil and chemical engineers, and experts on process safety;
- The intensity of a natural hazard may be difficult to predict and be higher than the anticipated "worst-case scenario". This can challenge the safety management of an installation. For example, the water levels during a flood may be higher than any previously experienced floods;
- The management of Natech risk requires anticipation of future changes and adaptation, for example using climate projections;
- Natural hazards can trigger or aggravate an accident by affecting critical utilities, for example making unavailable the electric power supply, alert systems or emergency shutdown systems;
- A Natech accident can be exacerbated where the natural disaster has caused inaccessibility of roads and transport (e.g. hampering site access for firefighters);
- Natural hazards can affect several installations at the same time and cause simultaneous accidents at one or more industrial sites. In addition, one natural hazard can trigger another one (e.g. an earthquake can cause a tsunami or a landslide), which could aggravate damage and needs to be considered in the worst-case scenarios assessed;
- During disasters caused by natural hazards, emergency responders may be occupied with managing the consequences on the population. Should a Natech accident occur at the same time, their availability and capability to mitigate any triggered chemical accidents can be limited. Releases of hazardous substances can also make difficult the response to the natural disaster;
- Particular attention should be paid to post-accident activities at hazardous installations, for example restart after a flood.

It is important for operations at hazardous installations that the triggering, propagation, and consequences of Natechs are properly considered in any accident scenarios.

4 How are Natech risks managed?

Industry and public authorities are the primary actors in the management of Natech risks.

Industry is required to implement the relevant policies and regulations while public authorities provide oversight and enforcement through a variety of mechanisms, including inspections of installations (see the example of the Natech Common Inspections Criteria), review of safety documentation, issuing of guidance, monitoring and investigating occurrences of accidental releases.

Industry is responsible for ensuring that the risk of the impact of natural hazards is appropriately assessed and mitigated in the design and operation of their installations.

The operator of an installation should, for example:

- Consider the natural hazards that can affect the installation, their likelihood and possible intensity;
- Based on this analysis, determine if and how the impact of these natural hazards could lead to a chemical accident;
- Develop Natech scenarios to help set up technical and organisational measures to prevent accidents, and also to prepare and respond if an accident would nevertheless occur;
- Establish which additional measures would be needed to minimise the risk and mitigate the consequences of Natech accidents from extreme scenarios which go beyond the assumptions made in the previous point (e.g. unavailability of protection systems);
- Include Natech accidents in emergency preparedness plans, and carry out training and exercises for this type of events;
- Apply learning from previous Natech incidents and monitor future changes to Natech scenarios.

This process takes place within a policy and regulatory context depending on the region/country the installation is located in (see example of the Seveso III Directive and the TRAS approach in Germany).

The role of public authorities in Natech risk management is, for example, to:

- Identify the natural hazards that can affect areas where hazardous installations are located (e.g. prepare natural hazard maps) and share this information with industry;
- Communicate on the likelihood of a natural hazard, in particular when the threat becomes higher (e.g. due to climate change) so operators can adapt their scenarios;
- Integrate natural hazards in land-use planning;
- Coordinate with industry on how to respond in case of a Natech accident requiring the intervention of public services (e.g. firefighters) and the warning of the population;
- Develop guidance to support industry in the implementation of the regulations;
- Cooperate with local and national stakeholders, as well as with neighbouring countries if a risk of a transboundary accident is identified.

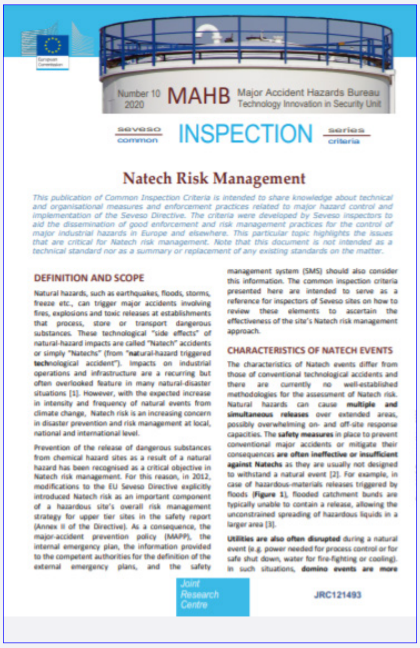
The Seveso III Directive of the European Union

The Seveso III Directive (2012/18/EU) is a European Union legislation addressing specifically the control of on-shore major accident hazards involving dangerous substances. It is aimed at the prevention of such major accidents, and at limiting their consequences for both human health and the environment should they nevertheless occur.

The Directive explicitly addresses Natech risks and requires that environmental hazards, such as floods and earthquakes, be routinely identified and evaluated.

More information at: https://ec.europa.eu/environment/seveso/

There are other stakeholders that play a role in the management of Natech risks, such as academia – e.g. for improving Natech risk analysis – and international organisations through facilitation of exchange of good practice between countries, setting an international baseline for Natech risk management, international emergency assistance and institutional capacity building.



Number 10 2020 **MAHB** Major Accident Hazards Bureau Technology Innovation in Security Unit

seveso common **INSPECTION** series criteria

Natech Risk Management

This publication of Common Inspection Criteria is intended to share knowledge about technical and organisational measures and enforcement practices related to major hazard control and implementation of the Seveso Directive. The criteria were developed by Seveso inspectors to aid the dissemination of good enforcement and risk management practices for the control of major industrial hazards in Europe and elsewhere. This particular topic highlights the issues that are critical for Natech risk management. Note that this document is not intended as a technical standard nor as a summary or replacement of any existing standards on the matter.

DEFINITION AND SCOPE

Natural hazards, such as earthquakes, floods, storms, freeze etc., can trigger major accidents involving fires, explosions and toxic releases at establishments that process, store or transport dangerous substances. These technological "side effects" of natural-hazard impacts are called "Natech" accidents or simply "Natechs" (from "**nat**ural-hazard triggered **tech**nological accident"). Impacts on industrial operations and infrastructure are a recurring but often overlooked feature in many natural-disaster situations [1]. However, with the expected increase in intensity and frequency of natural events from climate change, Natech risk is an increasing concern in disaster prevention and risk management at local, national and international level.

Prevention of the release of dangerous substances from chemical hazard sites as a result of a natural hazard has been recognised as a critical objective in Natech risk management. For this reason, in 2012, modifications to the EU Seveso Directive explicitly introduced Natech risk as an important component of a hazardous site's overall risk management strategy for upper tier sites in the safety report (Annex II of the Directive). As a consequence, the major-accident prevention policy (MAPP), the internal emergency plan, the information provided to the competent authorities for the definition of the external emergency plans, and the safety management system (SMS) should also consider this information. The common inspection criteria presented here are intended to serve as a reference for inspectors of Seveso sites on how to review these elements to ascertain the effectiveness of the site's Natech risk management approach.

CHARACTERISTICS OF NATECH EVENTS

The characteristics of Natech events differ from those of conventional technological accidents and there are currently no well-established methodologies for the assessment of Natech risk. Natural hazards can cause **multiple and simultaneous releases** over extended areas, possibly overwhelming on- and off-site response capacities. The **safety measures** in place to prevent conventional major accidents or mitigate their consequences **are often ineffective or insufficient against Natechs** as they are usually not designed to withstand a natural event [2]. For example, in case of hazardous-materials releases triggered by floods (**Figure 1**), flooded catchment bunds are typically unable to contain a release, allowing the unconstrained spreading of hazardous liquids in a larger area [3].

Utilities are also often disrupted during a natural event (e.g. power needed for process control or for safe shut down, water for fire-fighting or cooling). In such situations, **domino events are more**

Joint Research Centre

JRC121493

Natech Common Inspections Criteria

Common Inspections Criteria (CIC) aim to share knowledge about technical and organisational measures and enforcement practices related to major hazard control and implementation of the Seveso Directive. They are developed by the European Commission Joint Research Centre in partnership with the EU Seveso inspectors.

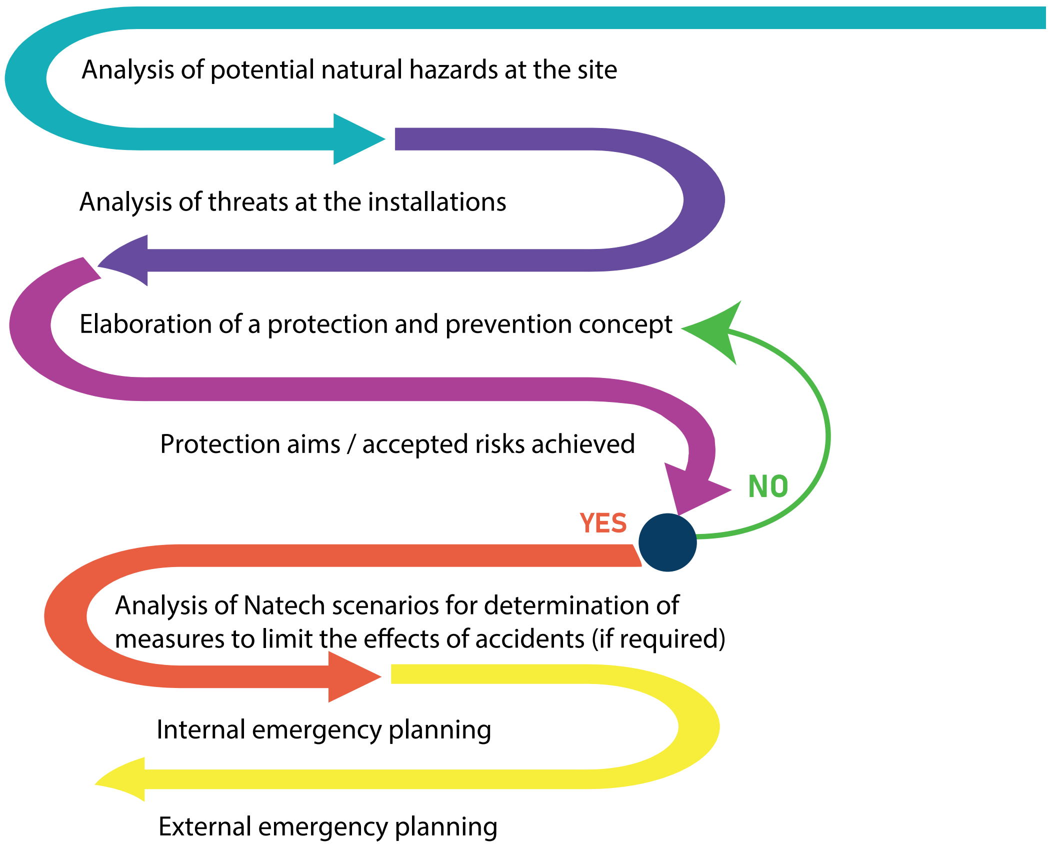
The Natech CIC highlights the issues that are critical for Natech risk management. It discusses Natech information in safety reports and emergency plans, provides guidance on identifying Natech risk and accident scenarios at site level, and presents measures for managing Natech risk.

More information at: https://minerva.jrc.ec.europa.eu/en/shorturl/minerva/jrc121493cic_natechnewpdf

The TRAS Approach, Germany

In Germany, Technical Rules for Plant Safety (TRAS) have been developed to define the responsibilities of operators of establishments mainly covered by the German Major Accidents Ordinance and the Federal Emission Control Act. The TRAS 310 and 320 provide a possible approach for Natech risk management by operators. More information can be found at: https://www.kas-bmu.de/tras-endgueltige-version.html.

A simplified approach includes the seven steps depicted in the figure below.



Record of Good Practices in Natech Risk Management

Examples of good practices for Natech risk management have been collected within the OECD Natech project framework. The library of examples was developed and is hosted by the German Environment Agency. More than 40 examples of such practices across countries and from different stakeholders are presented in easy-to-read fact sheets. See example below:

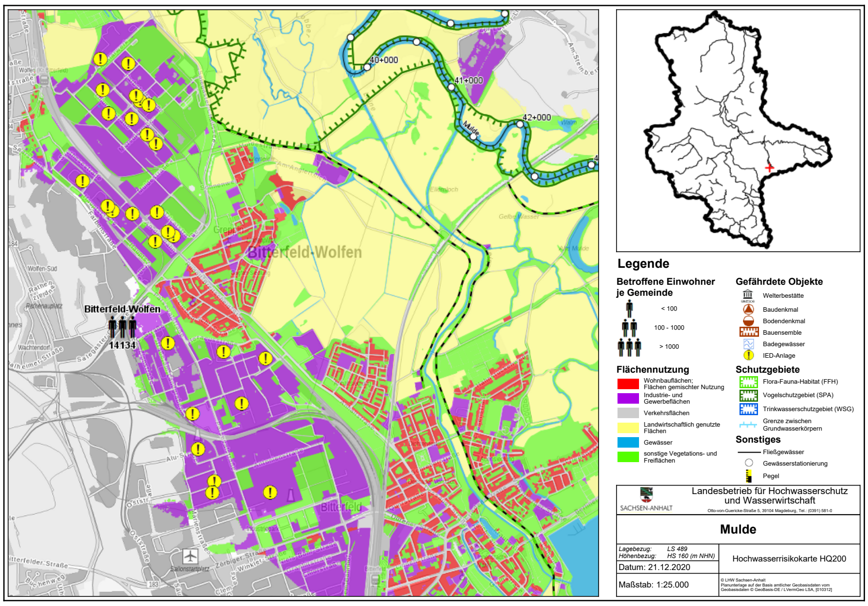
Umwelt Bundesamt

Interactive Flood Risk Map (Germany)

OECD GP Activity	UN SF Activity	UN SD Goals / Targets
1. Natural hazards identification and communication, NH (early) warning system	4. Enhancing disaster preparedness for effective responses	3.D Strenghten the capacity of all countries for early warning, risk reduction and management of national and global health risks

Classification according to OECD Guiding Principles, UN Sendai Framework Priorities/Activities, and UN SDGs and Targets.

Figure 1: Interactive flood risk map of Saxony-Anhalt, Germany (200 years flood risk map, not considering protection measures: Bitterfeld-Wolfen).

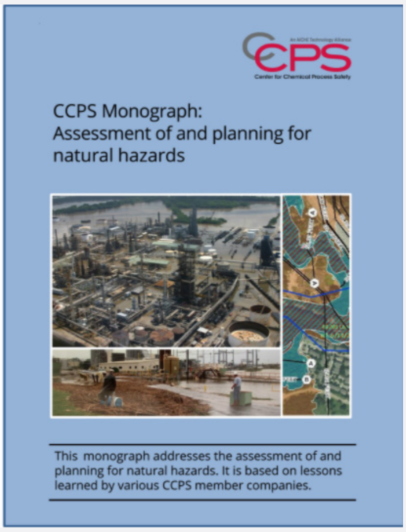


Installations according to the EU Industrial Emissions Directive

Short Facts	Natural Hazard(s) Considered
Governance approach: Hazard communication Source: Ministry for the Environment, Agriculture and Energy, State of Saxony-Anhalt (Ministerium für Umwelt, Landwirtschaft und Energie des Landes Sachsen-Anhalt) **Entry into force:** **Targeted Stakeholders:** The public **Scope of applicability**: National, regional	3.D Strenghten the capacity of all countries for early warning, risk reduction and management of national and global health risks

Source: Library of examples of good practice for Natech Risk Management, https://www.umweltbundesamt.de/en/topics/economics-consumption/plant-safety/examples-of-good-practice-in-natech-risk-management

Guidance and tools are developed to support Natech Risk Management by a variety of stakeholders. See the Examples of Good Practice In Natech Risk Management, or the CCPS Monograph: Assessment of and planning for natural hazards.



CCPS Monograph: Assessment of and Planning for Natural Hazards, 2019

The monograph developed by the Center for Chemical Safety (CCPS) intends to provide basic information, an approach for assessing natural hazards, means to address the hazards, and emergency planning guidance. The publication addresses the assessment of and planning for natural disasters. It is based on guidance provided by various governments, insurance agencies and CCPS, as well as lessons learned by CCPS member companies.

Source: AIChE (2019), *CCPS Monograph: Assessment of and planning for natural hazards,* American Institute of Chemical Engineers, Center for Chemical Safety, https://www.aiche.org/sites/default/files/html/536181/NaturalDisaster-CCPSmonograph.html

5 Natech risk management: examples of international support and transboundary cooperation

There are international activities to support national, regional, transboundary and global efforts to prevent Natech accidents and manage Natech risks. They aim to help with capacity-building, the development of tools and guidance, and to share experience and lessons learnt across countries. The organisations presented below are working closely together to coordinate efforts and benefit from the experience of their diverse membership.

Organisation for Economic Co-operation and Development (OECD)

Since 2008, the OECD Programme on Chemical Accidents investigates the specificities of Natech for the prevention, preparedness and response to chemical accidents, and supports the exchange of experience across countries (e.g. good practices, lessons learnt from accidents). Specific guidance for Natech risk management has been developed as part of its flagship publication "OECD Guiding Principles on Chemical Accidents Prevention, Preparedness and Response".
The programme has become an important forum to follow the development of Natech risk management measures in OECD countries and beyond and to share good practices and experience across countries, notably through regular international workshops. A record of examples of good practice for Natech risk management was also developed.

More of the work undertaken by the OECD on Natech:

oe.cd/natech

European Commission Joint Research Centre (JRC)

The JRC has strong expertise in Natech risks and their management and is often called upon by governments and international organisations to provide expert support in the field. The JRC has developed numerous publications, lessons-learned studies, risk assessment tools and guidance on the topic. It has developed eNatech, an online database to facilitate exchange of lessons learned from Natech accidents and near misses, as well as the web-based RAPID-N tool for rapid Natech risk analysis and mapping. RAPID-N is unique as it combines all necessary modules needed for Natech risk analysis in one tool. In 2020, the JRC published Natech inspections criteria for Seveso inspectors in collaboration with the EU Seveso Technical Working Group 2.

More of the work undertaken by the JRC on Natech:

- eNATECH accident database: https://enatech.jrc.ec.europa.eu/
- RAPID-N Natech risk assessment system: https://rapidn.jrc.ec.europa.eu/

The United Nations Economic Commission for Europe (UNECE) Convention on the Transboundary Effects of Industrial Accidents

Transboundary Natech risks are covered by the UNECE Convention on the Transboundary Effects of Industrial Accidents (Industrial Accidents Convention). More specifically, the Convention applies to *"the **prevention** of, **preparedness** for and **response** to industrial accidents capable of causing transboundary effects, including the effects of such accidents caused by natural disasters…"* Numerous guidelines, tools and projects have been developed within the framework of Convention that are relevant to Natech. For example, in the areas of prevention and mitigation, risk assessments should be developed and policies on land-use planning and siting of hazardous activities take account of their results, including consideration of Natech risks in a transboundary context. For preparedness, on- and off-site contingency plans should be developed and harmonized across borders, and tested, through table-top or field exercises, with due consideration of Natech risks. For response, countries should notify those that can be affected by the consequences of a Natech event, to exchange information on the nature of the risk and potential measures to take. With regard to prevention, preparedness and response measures, good practices have been developed covering relevant aspects of Natech risks on oil terminals, tailings management facilities and pipelines.

More of the work undertaken by the UNECE on Natech:
https://unece.org/industrial-accidents-convention-and-natural-disasters-natech

The UNEP/OCHA Joint Environment Unit (JEU)

The JEU has developed tools and guidance relevant to Natech. The Environmental Emergencies Centre (EEC) is an online tool designed to strengthen the capacities of national responders and humanitarians to respond to the environmental dimensions of emergencies, including Natech risks. It serves as a main knowledge hub and allows users to build on their own mechanisms and to draw on the resources and services of EEC partners. It also proposes online e-learning. The Environment and Humanitarian Action (EHA) Connect is an online repository of EHA tools and guidance, designed to meet the needs of humanitarian and environmental actors, and that is easily accessible. The JEU have also developed tools for rapid environmental assessment in emergency situations, such as the Flash Environmental Assessment Tool (FEAT) The JEU also provides mobilisation of international assistance and remote support. Whether in response to natural hazards, technological accidents or a combination of them, the JEU can mobilise technical expertise and equipment at short notice (48 hours) for deployment to affected countries. The unit also provides remote technical guidance and can activate the Remote Environmental Assessment and Analysis Cell for rapid situation analysis.

More of the work undertaken by the JEU on Natech:
https://www.eecentre.org/

World Health Organisation (WHO)

The Word Health Organisation has published information (WHO, 2018) on the role of the health sector in risk management for Natech accidents, their role in Natech prevention, preparedness for, response, and recovery, and three annexes on Natechs triggered by earthquakes, floods, and cyclones.

More of the work undertaken by the WHO on Natech:

https://www.who.int/

UN Office for Disaster Risk Reduction (UNDRR)

The key international instrument on disaster risk management is the Sendai Framework for Disaster Risk Reduction. The Framework covers natural hazards and technological hazards, including chemical/industrial hazards, making it an international platform for Natech risk management as well. Several publications relating to the implementation of the Framework include Natech risk, for example the Global Assessment Report on Disaster Risk Reduction issued by UN Disaster Risk Reduction (UNDRR) every second year (latest one published in 2019), and the Words into Action guideline: on Man-made/technological hazards.

More of the work undertaken by the UNDRR on Natech:

https://www.undrr.org/

The Impact of Natural Hazards on Hazardous Installations

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