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ADDENDUM NUMBER 2 TO THE OECD GUIDING PRINCIPLES FOR CHEMICAL ACCIDENT PREVENTION, PREPAREDNESS AND RESPONSE (2ND ED.) TO ADDRESS NATURAL HAZARDS TRIGGERING TECHNOLOGICAL ACCIDENTS (NATECHS)

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Environment Directorate

ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT

Paris 2015

Other OECD publications related to Chemical Accident Prevention, Preparedness and Response:

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Health Aspects of Chemical Accidents: *Guidance on Chemical Accident Awareness, Preparedness and Response for Health Professionals and Emergency Responders* (1994) [prepared as a joint publication with IPCS, UNEP-IE and WHO-ECEH]

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Internet Publication, Report of CCPS/OECD Conference and Workshop on Chemical Accidents Investigations (2002)

Special Publication, International Directory of Emergency Response Centres for Chemical Accidents (2002, revision of 1st edition published in 1992)

No. 10, Guiding Principles for Chemical Accident Prevention, Preparedness and Response (2003, revision of the first edition published in 1992)

No. 11, Guidance on Safety Performance Indicators for Industry, Public Authorities and Communities, (2003)

No. 12, Report of the OECD Workshop on Communication Related to Chemical Releases Caused by Deliberate Acts, Rome, Italy, 25-27 June 2003 (2004)

No. 13, Report of the OECD Workshop on Sharing Experience in the Training of Engineers in Risk Management, Montreal, Canada, 21-24 October 2003 (2004)

No. 14, Report of the OECD Workshop on Lessons Learned from Chemical Accidents and Incidents, Karlskoga, Sweden, 21-23 September 2004 (2005)

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No. 22, Addendum to the OECD Guiding Principles for Chemical Accident Prevention, Preparedness and Response (2nd ed.), (2011)

No. 23, Report of the Conference on Corporate Governance for Process Safety (14-15 June 2012, OECD, Paris) (2012)

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No. 25, Report of the Workshop on Natech Risk Management (23-25 May 2012, Dresden, Germany) (2013)

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FOREWORD

A project on Natechs - chemical accidents caused by natural hazards - was included in the 2009-2012 Programme of Work of the OECD Chemical Accidents Programme. The objectives of the project were to: (i) investigate the specific elements of prevention of chemical accidents, including spills of oil and oil products, as well as preparedness for and response to chemical accidents, resulting from the impact of natural hazards which are not part of national chemical accidents programmes; and (ii) make recommendations for good practices with respect to prevention of, preparedness for and response to Natech accidents.

A workshop on Natech Risk Management was held on 23-25 May 2012 in Dresden, Germany [ENV/JM/MONO(2013)4]. The purpose of the workshop was to discuss specific elements of the prevention of, preparedness for and response to chemical accidents caused by a natural hazard or natural disaster – for example, floods, storms, landslides, earthquakes, volcanic eruptions – and to make recommendations for best practices related to Natechs. The recommendations from the workshop were presented at the 22nd Working Group on Chemical Accidents meeting (WGCA), which included a recommendation to develop further guidance.

As a result the WGCA developed an addendum to *the OECD Guiding Principles on Chemical Accident Prevention, Preparedness and Response* to address Natech Risk Management. The addendum consists of a number of amendments to the *Guiding Principles* and of the addition of a new Chapter - Chapter 18 - to provide more detailed guidance on Natech prevention, preparedness and response.

This addendum has been developed as a supplement to the second edition of the OECD *Guiding Principles for Chemical Accident Prevention, Preparedness and Response,* published in 2003. This addendum is the second addendum to the Guiding Principles

The WGCA recommended that this addendum be forwarded to the Joint Meeting of the Chemical Committee and Working Party on Chemicals, Pesticides and Biotechnology, for consideration as an OECD publication.

This document is being published under the responsibility of the Joint Meeting of the Chemical Committee and Working Party on Chemicals, Pesticides and Biotechnology, which has agreed that it be unclassified and made publically available.

INTRODUCTION

This addendum has been developed as a supplement to the second edition of the OECD *Guiding Principles for Chemical Accident Prevention, Preparedness and Response*, published in 2003. It takes into account the results of the Workshop on Natural Hazards Triggering Technological Accidents (Natechs) Risk Management held 23-25 May 2012, in Dresden, Germany that was held under the auspices of the OECD Working Group on Chemical Accidents (WGCA).

The addendum contains:

- Amendments to existing text in the *Guiding Principles* to recognise the importance of prevention of, preparedness for and response to chemical accidents that may be triggered by natural hazards or natural disasters.

- A new chapter on Natechs (Chapter 18) included in Part E ("Special Issues"). This allows the *Guiding Principles* to capture more detailed guidance on how to address Natechs.

This addendum is not a stand-alone document; it can only be understood in conjunction with the 2nd edition of the *Guiding Principles*, which is available at: www.oecd.org/ehs or http://www.oecd.org/chemicalsafety/chemical-accidents/. To make it easier to identify the new and amended text, any changes are printed in blue.

This addendum is the second addendum to the Guiding Principles.[1]

[1] Addendum to the OECD Guiding Principles for Chemical Accident Prevention, Preparedness and Response (2nd ed.), see http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2011)15&doclanguage=en

BACKGROUND

The OECD published the first edition of the *Guiding Principles for Chemical Accident Prevention, Preparedness and Response* in 1992 in order to set out general guidance for the safe planning and operation of facilities where there are hazardous substances in order to prevent accidents and, recognising that accidents may nonetheless occur, to mitigate adverse impacts through effective emergency preparedness, land-use planning, and accident response. The *Guiding Principles* reflect the collective experience of the members of the WGCA and other experts in the field, and incorporates the conclusions and recommendations of the many workshops and other activities undertaken by the WGCA.

After a decade, the OECD reviewed the *Guiding Principles* and published an updated version in 2003 to take account of new experience and developments and to expand the scope to include transport interfaces. In 2011, a first Addendum was published to incorporate the results of five workshops held between 2003 – 2007.[2]

1. As part of its 2009-2012 Programme of Work, the OECD WGCA included a project on Natural Hazards Triggering Technological Accidents (Natech). The objectives of the project were to: (i) investigate the specific elements of prevention of chemical accidents, including spills of oil and oil products, as well as preparedness for and response to chemical accidents, resulting from the impact of natural hazards which are not part of national chemical accidents programmes; and (ii) make recommendations for good practices with respect to prevention of, preparedness for and response to Natech accidents.

2. A Workshop on Natech Risk Management was held on 23-25 May 2012 in Dresden, Germany [ENV/JM/MONO(2013)4]. The purpose of the Workshop was to discuss specific elements of the prevention of, preparedness for and response to chemical accidents caused by a natural hazard or natural disaster – for example, floods, storms, landslides, earthquakes, volcanic eruptions – and to make recommendations for best practices related to Natech.

3. Following this workshop, the WGCA agreed on the development of a second addendum to *the OECD Guiding Principles on Chemical Accident Prevention, Preparedness and Response* to address Natech Risk Management.

[2] These five workshops were:

1. Communication related to chemical releases caused by deliberate acts (Rome, Italy, June 2003)
2. Sharing experience in the training of engineers in risk assessment (Montreal, Canada, October 2003)
3. Lessons learned from chemical accidents and incidents (Karlskoga, Sweden, September 2004)
4. Human factors in chemical accidents and incidents (Potsdam, Germany, May 2007)
5. Safety in marshalling yards (Paris, France, October 2007)

ADDENDUM

The following is the Table of Contents from the *Guiding Principles*, amended as follows:

- The new Chapter added by this addendum is identified by italics.
- Any section that includes amended or added text is identified by an asterisk (*).

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Golden Rules (pages 21-24)[3]

Amendment of the Golden Rules to recognise that risks include Natechs: on page 23, under the "Role of Public Authorities", the third bullet is amended by adding "or accidents triggered by natural hazards or disasters)" to the fifth line:

- Monitor the industry to help ensure that risks are properly addressed.

  Public authorities should establish mechanisms for monitoring hazardous installations to help ensure that all relevant laws and regulations are being followed, and that the elements of a safety management system are in place and are functioning properly, taking into account the nature of the risks at the installations (including the possibilities of deliberate releases or accidents triggered by natural hazards or disasters). Public authorities can also take these opportunities to share experience with relevant employees of the installations.

PART A: PREVENTION OF CHEMICAL ACCIDENTS

Chapter 1 – General Principles (pages 29-32)

Addition of a new bullet under paragraph 1.6 to recognise the need for companies to take account of any new information about natural hazards when they review safety performance of their installations

♦ **Paragraph 1.6 - Industry should periodically monitor and/or review safety performance in hazardous installations in order to**:

- assess achievements with respect to the general goals set;
- determine how well specific safety-related policies and decisions have been put into practice;
- take into account new information related to the nature or extent of the risks at the installations, including risks of natural hazards or disasters and/or deliberate releases;
- focus resources where improvements are most needed;
- provide information to justify the adjustment or upgrading of goals and achieve further improvements;
- demonstrate management's commitment to safety and provide motivation for improvement;
- provide a basis for recognising good and inadequate performance;

[3] The page numbers indicate where the relevant text can be found in the 2nd edition of the Guiding Principles.

- provide information on safety achievements to the public authorities, community, shareholders and non-governmental organisations (NGOs); and

- provide input into education and training activities.

Chapter 2 – Industry (including management and labour) (pages 33 - 65)

Addition of a new bullet under paragraph 2.a.17 to reflect the idea that Safety Reports need to take into account the risks associated with possible natural hazards or disasters

♦ **Paragraph 2.a.17** These reports should demonstrate that appropriate steps are being taken to manage chemical hazards. The reports should be reviewed regularly and updated, as appropriate. They should include a description of, or a reference to, documents addressing:

- The installation, including its purpose, activities, layout, intrinsic hazards, hazardous substances, personnel, services, and technical equipment.

- The area surrounding the installation, including sensitive environments, the population and activities in the area (including commercial, residential and industrial activities.

- Natural hazards in the area which are potential triggers for Natechs, such as those related to extreme temperatures, high winds, floods, storms, earthquakes and wildfires.

- Hazard identification and risk assessment of the installation (see Section 2b on Hazard Identification and Risk Assessment).

- The on-site emergency plan, including the relationship with off-site plans and communication and co-ordination with emergency response personnel (see Chapter 5, section b on Emergency Preparedness and Planning - Industry).

- The corporate Safety Policy (see paras. 2.a.7 – 13).

- The enterprise's safety management system (see paras. 2.a.14 - 15).

- The procedures for internal reporting of incidents (see Chapter 14, section c on Incident Documentation and Reporting – Industry).

Amendment to paragraph 2.b.2 to recognise that the choice of a risk assessment approach should take into account the nature of the risks, including risks of Natechs and deliberate releases

♦ **Paragraph 2.b.2** When undertaking a risk assessment, management should carefully consider the various possible approaches and methods available. They should choose an approach/method that is appropriate for the particular circumstances, since all approaches/methods have strengths and weaknesses and none is perfect.

- The choice of a particular approach/method should be governed by a number of factors, including:

- the objective/purpose of the risk assessment;
- the estimated extent and nature of the risks (including the possibilities of deliberate releases or accidents resulting from natural hazards or disasters);
- the availability and adequacy of data;
- the expertise and resources needed for a particular approach/method, and their availability;
- the history of incidents at the installation and other related installations;
- unavoidable constraints on the process;
- the socio-political context in which the assessment will be carried out; and
- the assumptions on which the approach/method is based.

➢ There should be a clear statement of objectives for any risk assessment activity, so that an appropriate risk assessment approach/method can be selected.

Amendment to paragraph 2.b.3 to recognise that there will be data limitations concerning natural hazards in the vicinity of installations

♦ **Paragraph 2.b.3** Risk assessments should be accompanied by information concerning the assumptions, data limitations and uncertainties imbedded in risk assessment approaches/methods, as well as in decision- making processes, so that the results of risk assessments can be appropriately utilised.

➢ It is important to address possible data limitations and inappropriate selection of data in order for the results of the assessments to be reliable and comprehensive.

➢ ~~For example,~~ There may be gaps and inadequacies in the data available on, for example, equipment failure rates and modes, human error predictions, long-term or delayed health effects of acute exposures, the likelihood and extent of natural hazards or disasters in the area, and the effects of chemicals on the environment.

➢ Data limitations can be managed, in part, through the use of less detailed, more generic approaches/methods, or the use of comparative assessments to aid in choosing among alternatives options. The use of comparative assessments normally involves similar assumptions, limitations, and uncertainties and therefore their effect on the assessment results is dissipated

Addition of a note referencing a Chapter on Natechs in paragraph 2.b.6

See Chapter 18 on Natechs

Addition of a new bullet under paragraph 2.b.8 to recognise that risk assessments may need to be revisited when there is new information concerning natural hazards

♦ **Paragraph 2.b.8** Risk assessment should be a continuous and evolving process. Assessments should be reviewed and reassessed periodically, and when there are indications that a revision may be needed.

- A risk assessment may need to be revisited when, for example:
  - there are new or changed processes at hazardous installations, or significant changes in transport of hazardous substances;
  - incidents occur;
  - new technology offers scope for improvements;
  - the experience of labour and/or management is at odds with the risk assessment;
  - new information about the behaviour or effects of substances and processes becomes available;
  - there is new information about the potential for natural hazards or disasters that could trigger a chemical accident; and
  - there are proposals for new construction or other developments inside the premises of the installation or nearby.

- Furthermore, risk assessments should be reviewed routinely to test assumptions, to try to resolve uncertainties, and to take advantage of experience and improvements in methods.

Addition of a new bullet under paragraph 2.c.1 to recognise that choice of sites for new hazardous installations should take into account the risks associated with natural hazards or disasters. In addition to new text, there is a change in formatting

♦ **Paragraph 2.c.1** Management of an enterprise, when choosing possible sites for new hazardous installations, should abide by land-use planning and zoning requirements and guidance.

- Management should seek sites which would minimise the adverse effects to health, the environment, and property in the event of an accident at the installation or as a result of transport of hazardous substances to and from the installation.

- Management should take into account the risks posed by natural hazards and disasters when considering possible sites.

- Management and public authorities (in particular, those responsible for land- use planning decisions) should co-operate in order that hazardous installations are located and built so as to minimise the risks to human health, the environment and property.

Amendment to paragraph 2.c.2 to clarify that plans for new installations (or significant modifications) take into account natural hazards

♦ **Paragraph 2.c.2** Management of an enterprise proposing to construct a new hazardous installation or make a significant modification to an existing installation should develop a scale plan of the proposed development. This scale plan should reflect information made available by public authorities and should show:

- the locations and quantities of the hazardous substances present on-site relative to the surrounding area;
- the nature of land-use in adjacent areas;
- the local population and areas of local environmental significance; and

- the potential off-site effects posed by their proposal.

➢ Management should also describe details of the processes which will involve hazardous substances, the inventory of hazardous substances to be stored, ~~and~~ the conditions under which the hazardous substances are to be handled, and the risks associated with possible sites (including risks of accidents resulting from natural hazards / disasters or deliberate releases). Furthermore, management should develop an assessment of the consequences for human health and the environment from the proposed installation.

➢ These assessment-related activities should be carried out in conjunction with local authorities and the public as early as possible in the process of planning for the installation so as to facilitate siting decisions and consideration of cost-effective alternatives.

➢ The scale plan, and related information and assessment, should be provided to the appropriate authority.

Amendment to paragraph 2.c.3 to take account of new information to safeguard existing installations

♦ **Paragraph 2.c.3** Management of hazardous installations and public authorities should discuss means for reducing risks at existing installations so that they comply with current land-use planning and zoning laws and guidance (*e.g.*, if the laws/guidance have changed since the installation was built, ~~or~~ if residential or other developments have been built in the vicinity of the installation, or there is new information about natural hazards that could trigger a chemical accident).

➢ Management should make a good faith effort, as appropriate, to reduce risks at existing installations so that they comply with current laws and guidance.

➢ Management should try to work with other stakeholders in the community to try to prevent residential and other developments (including, for example, schools, hospitals, and shopping areas) from being built near their hazardous installations if this would lead to inappropriate risks to health, the environment or property off-site.

Addition of a new bullet under paragraph 2.c.4 to recognise that installation design should take into account natural hazard risks

♦ **Paragraph 2.c.4** Safety measures should be incorporated at the earliest conceptual and engineering design stages of an installation to enhance the intrinsic (inherent) safety of the installation wherever practicable.

➢ Employing inherently safer technology in the manufacture, transport and use of chemicals (*e.g.*, reducing inventories of hazardous substances, using safer production processes, and enhancing secondary containment) increases the security of hazardous installations.

➢ Processes should be designed to contain, control and minimise the quantity of hazardous intermediate substances to the extent that this would increase safety. Where this is not

possible, the quantity of hazardous intermediates produced should be reduced to the amount required for the next stage of production so that quantities held in storage are kept to a minimum.

- The safety measures should take into consideration the possibilities of human and/or technical errors, as well as deliberate acts such as sabotage or vandalism, occurring at an installation.

- The safety measures should take into consideration the possible natural hazards that could trigger a chemical accident including, for example, extreme temperatures, floods, high winds, wildfires and earthquakes.

- The safety measures should make compliance with safety procedures as easy as possible.

- The design of hazardous installations should take into account the human factor and human limitations, and be in accordance with ergonomic principles. The design should take into consideration the psychological, physiological, and cognitive abilities and limitations of people who have significant tasks at hazardous installations. In this regard, the design should make the actions required by operators as simple as possible, consistent with their cognitive abilities, thus minimising the possibility of errors.

- In order to avoid designing a facility that has latent operating errors, tests should be used to determine whether the operating design of the installation is feasible and practical (e.g., that it takes account of the limited quantity of information that can be processed by humans under conditions operators might face at the installation).

- Engineering design principles concerning safety apply not only to new plant and process design, but also to modifications of existing plants and processes, as well as to research activities

Addition of a new bullet under paragraph 2.c.5 and amendment of the text and format to clarify that the design should not only take into account standards and codes, but also take into account relevant developments

♦ **Paragraph 2.c.5** To achieve a high level of safety, the design of new installations and significant modifications of existing installations should incorporate the relevant, most up-to-date international standards, codes of practice and guidance relevant to hazardous installations that have been established by public authorities, enterprises, industry and professional associations, and other bodies.

- The standard, codes of practice and guidance should take into account process risks associated with technological or process-related accidents as well as risks associated with accidents caused by deliberate acts or natural hazards/disasters.

- Such standards, codes of practice and guidance should~~, however,~~ be considered minimum requirements.

- Improving safety is a dynamic process that should reflect advances in knowledge and technology.
- Therefore, these standards, codes and guidance should be supplemented by guidance developed from within the enterprise (embodied in in-house engineering design guides and specifications) as a result of operational experience and specialist knowledge, as well as information available from external sources concerning process safety, natural hazards that could impact the installation, and other issues that affect the likelihood of a chemical accident or the adverse impacts should an accident occur.

➢ Existing installations should be assessed to determine whether they meet these standards, codes and guidance. Where they do not meet the standards, appropriate improvements should be carried out as soon as practicable.

Addition of a reference to paragraph 2.c.6 to clarify that natural hazards are included among the external forces that could cause damage

♦ **Paragraph 2.c.6** The design of a hazardous installation should integrate the appropriate equipment, facilities and engineering procedures that would reduce the risk from hazards as far as is reasonably practicable (*i.e.*, all measures to reduce risk should be taken until the additional expense would be considered to far exceed the resulting increase in safety).

➢ In this regard, consideration should be given to the use of "inherently safer" process and installation design to reduce risk. Inherently safer approaches involve careful selection of the process, along with good design of the installation (in effect designing out certain hazards, minimising the effects of human error and better tolerating errors which might occur). Such approaches include the following concepts, to the extent that they decrease overall risk:

- *(no change to the list)*

➢ Systems designed specifically to increase process safety dealing with, for example, pressure relief and fire and explosion detection, should be included in the engineering design of new and existing hazardous installations, taking into account possible accident scenarios.

➢ Hazardous installations should be designed to prevent or minimise the exposure of employees to hazardous substances, thereby reducing the need for personal protective equipment.

➢ For equipment critical to safety (such as pressure vessels or control instruments), engineering design should be subject to a recognised certification or verification procedure.

➢ In the design of hazardous installations, consideration should be given to the provision of redundant safety-related utility supplies (such as electricity for control systems).

- Consideration should also be given to maximising protection of vulnerable parts of the enterprise in order to avoid damage from external forces (*e.g.*, natural hazards/disasters, sabotage, terrorism, vandalism, theft).

*Addition of a new bullet under paragraph 2.c.13 to state that site layout should take account of natural hazards (*e.g.*, storage of hazardous substances should not be in areas that are likely to be flooded in the event of a storm)*

2.c.13 In the design phase, management should ensure there is adequate consideration of the site layout guided by overall safety goals. Particular regard should be given to:

- The establishment of safe separation distances to minimise any "knock on" or "domino" effects either on-site, within the boundaries of the installation, or off-site involving other enterprises.

- The location of hazardous processes and substances relative to the location of personnel and to critical safety-related equipment and instruments.

- The location of hazardous processes and substances in light of natural hazards, in order to minimise the likelihood of an accident in the event of a natural disaster.

- The location of offices, control rooms and other premises so as to minimise the adverse effects to health and increase the ability to maintain control of the installation in the event of an accident.

- Possible effects on the local community and environment.

Addition of a phrase under paragraph 2.d.4 to emphasise that abnormal conditions include extreme meteorological events. In addition to new text, there is a change in formatting

♦ **Paragraph 2.d.4** Procedures should exist to ensure effective protection against accidents involving hazardous substances during abnormal conditions. Abnormal conditions could include, for example:

- when critical instruments, alarms and emergency equipment are not functioning;

- when there are unusual (short-term) production demands, extreme overtime work or a slow-down in production;

- when there are resource constraints (including staffing and financial resources); ~~or~~

- when there are emergency shutdowns or evacuations; or

- when there are severe meteorological conditions such as extensive precipitation, floods, high winds or extreme temperatures.

Modification of the first bullet under paragraph 2.d.34 to emphasise that education and training of employees should incorporate knowing what to do in the event of a natural disaster

♦ **Paragraph 2.d.34** Management should take all reasonable measures to ensure that all those employed at a hazardous installation, including temporary employees and contractors, receive appropriate education and training and are competent to carry out their tasks under both normal and abnormal conditions.

- This education and training should address:
  - hazard identification, risk evaluation, and appropriate corrective measures to address safety concerns;
  - risk prevention and mitigation;
  - actions that should be taken in unusual or emergency situations, including the prediction or occurrence of a natural hazard or disaster;
  - correct materials handling procedures;
  - human factors and risk communication;
  - the role played by people in the context of different aspects of design and operation of the installation, including control (internal and external inspection, audits); and
  - any special hazards unique to their job.

- Safety training should be part of the initial induction training given to all new employees to create safety consciousness and commitment. There should also be regular follow-up training and education. During slower work periods, or as circumstances dictate, consideration should be given to using employees' free time for education and training activities.

- Training should be structured to give all employees the skills they need to do the job to which they have been assigned, and be sufficiently broad-based so that employees understand the workings of the installation, equipment, operations and processes, and possibilities for abnormal situations. The approach to education and training should create the high level of awareness necessary not only to prevent accidents but also to respond to abnormal occurrences quickly and effectively.

- Arrangements should be made to ensure that specialised training needs at all levels are properly identified and are appropriately satisfied.

- All employees should be encouraged and trained to think through their assigned tasks and how they can be carried out most safely, rather than just carrying them out mechanically. Training should make clear not only what employees are required to do, but also why certain actions are necessary for safety. In this regard, training should instil in employees the confidence to raise concerns related to safety (both technical and management issues), when appropriate.

- Labour and their representatives should be involved in the development of education and training programmes.

Addition to the first bullet under paragraph 2.i.7 to highlight the fact that when transferring technology, an enterprise should take into account the local natural hazards and meteorological conditions

♦ **Paragraph 2.i.7** Whenever an enterprise transfers process technology or other safety-related technology, management of that enterprise should strive to ensure that the technology will be applied in a way which will result in a level of safety equivalent to that achieved in the technology supplier's own installations using that technology.

- Enterprises transferring process or other safety-related technology for hazardous installations have a responsibility to develop the technology and associated operating procedures so that installations can be operated to an acceptable level of safety, recognising that certain safety technology may not be appropriate in all locations, that local meteorological conditions and natural hazards might affect the level of hazards and risks at an installation, and that practices of management and other employees can be significantly affected by local cultural and administrative conditions.
- All such transfers of technology should be accompanied by related safety information.
- The technology supplier should provide assistance to the technology receiver for education and training.
- The technology supplier should not seek to transfer technology deemed to be unacceptable at its sites or otherwise rejected by competent authorities on grounds of safety.

Chapter 3 – Public Authorities (pages 67 – 77)

Addition under paragraph 3.a.11 of a reference to Natechs when public authorities determine which installations have the potential for chemical accidents

♦ **Paragraph 3.a.11** Public authorities should establish criteria for identifying hazardous installations considered to have the potential to cause accidents. These criteria may be based on, for example, the specific substances and/or categories of substances present in the installation and their process conditions, and their potential to cause serious harm to health, the environment or property.

- Natech risks should be taken into account when public authorities develop criteria for identifying installations with the potential for causing serious harm to health, the environment or property in the event of an accident.

Addition of a new paragraph, which follows existing paragraph 3.a.19

3.a.19.a Public authorities should establish arrangements for the development, dissemination and use of natural hazard maps, so that Natech risks can be taken into account in risk assessment and risk management of hazardous installations, as well as in land-use planning and emergency planning and response.

- Natural hazard maps should address all types of hazards that may cause Natechs, to the extent practicable.

- Natural hazard maps should be regularly updated and made publicly available.

- Neighbouring countries should co-operate in the development of hazard maps, where there are cross-border hazards.

See Chapter 18 on Natechs

Addition of a new bullet under paragraph 3.b.3 to recognise that natural hazards should also be taken into account in land-use planning decisions

♦ **Paragraph 3.b.3** Land-use planning decisions by public authorities related to hazardous installations should take into account the cumulative risk to the community of all hazardous installations in the vicinity. In some cases it may be preferable from a safety perspective to centralise hazardous installations in one location, while in other cases it may be preferable to keep hazardous installations apart.

- Land-use planning decisions should take into account the possibility of a domino effect, where a chemical accident in one site could cause an accident in neighbouring site(s).

- Decisions should consider the value of keeping suitable distances between a hazardous installation and other developments in the vicinity, in order to reduce the risks of adverse effects in the event of an accident.

- Decisions should consider the value of establishing suitable distances between hazardous installations and populations and sensitive environments in order to reduce the risks of adverse effects in the event of an accident.

- Decisions should take into account the natural hazards in the area in order to reduce the risks of a chemical accident and the adverse effects in the event of an accident.

PART B. EMERGENCY PREPAREDNESS/MITIGATION

Chapter 5 – Emergency Preparedness and Planning (pages 87 – 102)

Amendment of the final bullet under paragraph 5.a.1 to emphasise the need to take into account Natech risks in emergency planning, and to refer to Chapter 18 for further guidance

♦ **Paragraph 5.a.1** Public authorities (at all levels) and management of hazardous installations should establish emergency planning activities/programmes for accidents involving hazardous substances.

- The objective of emergency planning activities/programmes should be to put into place the arrangements needed to localise any accidents that may occur and, if possible, contain them and thereby minimise their harmful effects on health, the environment, and property.

- A prerequisite for effective emergency planning is the identification of the hazardous installations located within the area to be covered by the emergency plan.

- On-site and off-site emergency plans should be prepared, that include details of appropriate technical and organisational procedures that are appropriate to minimise the effects on health, environment and property (both on-site and off-site) in the event of an accident.

- Other risks, such as the risks of transport accidents involving hazardous substances, as well as risks associated with natural hazards and disasters, should be taken into consideration in emergency planning for hazardous installations.

See Chapter 18 on Natechs

Addition of a new bullet under paragraph 5.a.2 to emphasise that natural hazard maps should be taken into account in the emergency planning process

♦ **Paragraph 5.a.2** As part of the emergency planning process, there should be an elaboration of possible scenarios, and an identification of the potential risks and the geographical zones where effects are likely to occur in the event of an accident. The zones should indicate, *inter alia*, the public potentially affected and those areas for which decisions concerning evacuation, sheltering in place, or other actions to limit exposure may have to be taken. The identification of such zones should also provide an indication of the nature and extent of resources that may be needed in the event of an accident.

- The identification of potential risks and zones where effects are likely to occur should take into account natural hazard maps.

- The identification of zones where exposures are likely to occur should take into account the possibility that adverse effects could result from: direct contact with toxic or irritating substances (for example, through eye exposure, skin contact or inhalation); thermal radiation or overpressure; indirect exposure (for example, through ingestion of contaminated food or water); or indirect injuries (for example, from collapsing structures, projectiles or fire).

- The identification of zones where effects are likely to occur should indicate the existence of critical infrastructures (including transport facilities and roads), environmentally sensitive areas, and developments with sensitive populations (such as hospitals, nursing/retirement homes, shopping malls, schools or other areas where children congregate). In the case of developments with sensitive populations, it may be necessary to make direct contact, with specific instructions, in the event of an accident.

- The emergency planning process should take into account the identification of such zones. The identification of possible impacts should be made on the assumption of worst-case and most probable accident scenarios.

- At the time of an accident, the areas at actual risk will need to be determined based on the nature of the hazardous substance(s) released, the weather conditions/prevailing winds, and likely dispersion of the substances into the environment.

Addition of a new bullet under paragraph 5.a.12 to emphasise that Natech should be considered in the process of reviewing and testing emergency plans

♦ **Paragraph 5.a.12** On-site and off-site emergency plans should be tested and reviewed regularly, updated as appropriate, and maintained up-to-date taking into account, for example, changes in the nature of the risks, new residential and commercial developments in the area, improvement in response capabilities, lessons learned from exercises/tests and from application of plans during accidents and near-misses, and changes in personnel.

- Emergency plans should be reviewed to be sure they take into account preparedness for and mitigation of Natechs, as well as the possible impacts of natural hazards on infrastructure and response capabilities.

- Testing of emergency plans at appropriate intervals is critical for ensuring that they are adequate, complete and realistic, and that the various plans applicable in an area (on and off-site) are compatible. Testing also provides a means to identify gaps or needs with respect to the availability of appropriate personnel (including training needs), equipment, supplies and information. In addition, testing increases the confidence of response personnel in being able to deal with real emergencies.

- Exercises can test separately different components of a plan and can include simulations through, for example, table-top computer exercises.

- There is a need to determine an appropriate testing regime, and which aspects should be tested at a given time (since not all aspects of a plan will be subjected to each test). For example, priority may be given to testing areas that are suspect or have not been tested for some time.

- Some exercises should be undertaken in adverse conditions (for example, outside normal working hours, during inclement weather, etc.) to reveal the range of limitations and problems inherent in the emergency plans.

- The individuals who will be involved in the event of an accident should be involved in the tests/exercises. For example, since response to an accident would require decision-making by high-level officials (from industry and from public authorities), those officials should be involved in relevant tests. In addition, members of the public should be involved in appropriate parts of the tests/exercises.

- If the activity involved in an exercise/test might raise questions or concerns on the part of the public, they should be told about the exercise/test in advance.

- Maximum benefit is gained from conducting exercises/tests in a "no blame environment" (i.e., no blame is assigned for errors or problems identified). In such a case, all participants can feel free to be open and honest in their evaluations without fear of repercussions.

- The use of independent observers during exercises facilitates an objective review of any deficiencies or defects in the emergency plans.

- For testing off-site plans, consideration should be given to combined testing of plans for a given area (i.e., where there is more than one hazardous installation in the area, or where an accident may affect more than one community within a country or across the border). This is more cost-efficient and can provide improved insights into limitations in the planning.

- Tests should also take into account transport of hazardous substances under the responsibility of hazardous installations.

- The results of exercises/tests of emergency plans, and any revised emergency plans, should be published and made widely available to inform all those who may have a role to play in the event of an accident, and to provide a means to allow others to learn from the experience.

Addition of a point under paragraph 5.a.17 to clarify that notification systems should include awareness of possible natural disasters (e.g., flood, extreme temperatures or high wind warnings)

♦ **Paragraph 5.a.17** Systems and procedures should be in place for the rapid detection of an accident or imminent threat of an accident, and for the immediate notification of emergency response personnel.

- Warning systems should be developed to provide management of hazardous installations and local communities with warnings of natural hazards that can trigger Natechs (including, for example, floods, storms, high winds, extreme temperatures).

Amendments to paragraph 5.c.4 related to integration of emergency plans, and to refer to Chapter 18 for further guidance

♦ **Paragraph 5.c.4** Public authorities at all levels should integrate emergency planning for hazardous installations with emergency planning for natural disasters (such as floods, earthquakes and storms) and civil defence, as these activities involve many of the same requirements. This ~~integration~~ should result in co- ordinated and consistent emergency plans, and in a co-ordinated command structure. It should be kept in mind that natural hazards or disasters can trigger ~~chemical accidents at hazardous installations~~Natechs, and can impede emergency response activities.

See Chapter 18 on Natechs

Chapter 6 – Land-Use Planning (pages 103-104)

Addition of a bullet under paragraph 6.1 to emphasise that Land-use Planning decisions should take into account natural hazards

♦ **Paragraph 6.1** Public authorities should establish land-use planning arrangements to ensure that new hazardous installations are appropriately sited with respect to protection of health, environment, and property in the event of an accident involving hazardous substances. In addition, land-use planning arrangements should control other developments (residential, commercial, public infrastructure, etc.) in the vicinity of hazardous installations.

- Land-use planning arrangements should not have unintended effects of increasing the overall level of risk of individuals potentially affected in the event of an accident.

- In this regard, public authorities should take into account concerns for environmental and social equity.

- When making decisions concerning siting of installations, public authorities should take into account all of the hazards in the area in order to limit, to the extent possible, any overall increase in risk to health, the environment and property.

  - In this regard, public authorities should assess and take into account the risks posed by natural hazards.

Chapter 7 – Communication with the Public (pages 105 – 108)

Addition of a bullet under paragraph 7.4 specifying that information to the public should include known natural hazards in the vicinity of hazardous installations

♦ **Paragraph 7.4** The potentially affected public should also be provided with additional information about the hazardous installations in their vicinity, without their having specifically to request it. This information should address:

- the types of industries in their area and the chemicals that are produced and used in these installations (the common names or, if more appropriate, the generic names or general danger classification of the substances involved at the installation that could give rise to an accident capable of causing serious off-site damage, with an indication of their principal harmful characteristics);

- the name(s) of the enterprise(s) responsible for the installation(s) and the address(es) of the installation(s);

- information relating to the types of possible accidents that could cause serious off-site damage, and their potential effects on health, the environment, and property;

- information about known natural hazards that might trigger a Natech (such as the fact that the installation is on a fault line or in a flood risk zone);

- the preventive measures that have been taken to minimise the likelihood of accidents;
- a reference to the off-site emergency plan;
- point(s) of contact, where further explanatory information and clarifications can be obtained and feedback can be provided to rescue services and other authorities; and
- information concerning expected activities at the installation that may raise concerns of neighbours (*e.g.*, flares, odours).

Amendments to paragraph 7.9 to make clear that education to the general public should include information about Natechs

♦ **Paragraph 7.9** In addition to targeting information at the potentially affected public, public authorities should also educate the general public about the risks associated with accidents involving hazardous substances (and other types of emergencies including Natechs) and the types of actions that should be taken in the event of an accident. This is important because people are mobile (moving in and out of risk zones), and because certain sources of risk are mobile.

PART D. FOLLOW-UP TO INCIDENTS

Chapter 14 – Incident Documentation and Reporting (pages 131 – 132)

Amendments to paragraph 14.b.2 to make clear that procedures for documentation of accidents and incidents should apply to Natechs. In addition to new text, there is a change in formatting.

♦ **Paragraph 14.b.2** Public authorities should establish appropriate criteria, requirements and procedures for documentation of all significant incidents involving hazardous substances, including Natechs.

- This includes both the documentation by emergency response personnel, as well as documentation by the management of the installation where the accident occurred.
- Efficient documentation by industry and public authorities can make an important contribution to the safe operation of hazardous installations. Incident documentation also helps to instil public confidence that proper actions will be taken to avoid similar incidents, or incidents with similar consequences, in the future.
- Documentation should not be limited to significant accidents, but should also address important near-misses.
- Documentation should provide the basis for determining which incidents should be subject to investigations, and should help identify trends and areas of concern, identify causes and consequences of incidents, provide a basis for

learning from experience, and lead to remedial action to correct any deficiencies in technology or procedures which led to the incident.

- Reports of past accidents submitted by industry to authorities should include information on the environmental, as well as health effects of accidents. Economic impacts of accidents should also be assessed to the extent relevant information is available (with economic impacts broadly defined to include, for example, both direct and indirect costs).

- Public authorities should encourage the voluntary reporting by enterprises to public authorities of accidents and significant near-misses beyond what is legally required.

PART E. SPECIAL ISSUES

Chapter 16 – Transboundary/International Issues (pages 145 – 161)

Addition of a new paragraph calling for neighbouring countries to co-operate with respect to Natechs, and referring to Chapter 18 for further information

16.a.1.a Neighbouring countries should co-operate with respect to Natech prevention, preparedness and response.

See Chapter 18 on Natechs

Chapter 17 – Fixed Installations and Transport (pages 163 – 172)

Amendments to paragraph 17.c.2 to clarify that there are other natural hazards that might impact the safety of pipelines

♦ **Paragraph 17.c.2** Land-use planning considerations and risk assessments should be taken into account both in the routing of new pipelines (*e.g.*, to limit proximity to populated areas to the extent possible), and in decisions concerning proposals for new developments/building in the vicinity of existing pipelines.

- Environmental impact assessment for geological and other natural hazards should also be taken into account in order to avoid (to the extent possible) hazardous ~~geologic~~ environments, such as areas susceptible to sinkholes, ~~and~~ seismic activity, and floods.

- Routing of pipelines should be chosen to minimise adverse impacts in the event of an accident, and to facilitate access for maintenance and for emergency response personnel.

Chapter 18 - Natechs

This is an entire new chapter on Natechs (Chapter 18) included in Part E ("Special Issues") of the Guiding Principles. This allows the Guiding Principles to capture more detailed guidance on how to address Natechs.

This Chapter addresses prevention, preparedness and response related to chemical accidents, including spills of oil and oil products, triggered by (or made worse by) natural hazards or natural disasters including, for example, floods, storms, landslides, earthquakes, volcanic eruptions, high winds, extreme temperatures and wildfires. These "Natechs" include accidents at fixed installations including transport interfaces and pipelines.

This Chapter supplements the rest of the Guiding Principles, *which also apply to Natechs. However, Natechs require additional considerations as there are a number of issues that go beyond those of "ordinary" chemical accidents. For example, natural disasters can:*

- *impact key infrastructure elements such as electric grids, energy and water supplies, communication systems and transport routes;*
- *put a strain on emergency and medical response capabilities; and*
- *trigger accidents at several installations at the same time.*

In addition, more than one hazard may appear at the same time (e.g., *heavy winds and precipitation) and one natural hazard can trigger others (*e.g., *earthquake followed by a tsunami).*

In assessing Natech risks, public authorities and industry need to consider whether to address probable risks or all possible risks. To get a complete picture, one approach would be to identify the worst case scenarios, as well as the more probable but potentially less destructive scenarios.

Further effort is needed to improve understanding of natural hazards and how they may impact chemical accident prevention, preparedness and response. It is also important to keep in mind that recent studies predict that climate change will lead to more frequent and more intense natural disasters, often in areas where there are large chemical and petro-chemical facilities. This means a greater risk of Natechs, with the potential for significant harm to human health, the environment and the economy in the vicinity of hazardous installations.

a. Hazard Mapping

18.a.1 Public authorities should collect data related to natural hazards and natural disasters, and use this to develop natural hazard maps, which are important tools for the dissemination of information on natural hazards.

- Hazard maps should include all hazards in the relevant region that could trigger or worsen chemical accidents, to the extent practicable.
- The maps should be used for decisionmaking related to all aspects of chemical accident prevention, preparedness and response.
- The maps should be regularly reviewed and updated, as appropriate, taking into account new information and new methods for understanding natural hazards.

- Public authorities should disseminate the natural hazard maps to industries and communities that are potentially affected in the event of a chemical accident, and make the maps publicly available.

- Neighbouring communities should cooperate in the development of natural hazard maps to the extent relevant.

18.a.2 Adequate training should be provided to those responsible for preparing and using natural hazard maps in the context of, for example, siting of hazardous installations, land-use planning, designing and operating hazardous installations, and emergency planning.

18.a.3 Further efforts should be undertaken to improve the methodologies and tools for preparing hazard maps and for Natech risk analysis.

- This includes ways to improve the reliability of data related to the probability and intensity of natural hazards in a region, and to understand the potential impact of climate change on natural hazards.

- Public authorities and other stakeholders should share experience in the development of natural hazard maps.

- Countries should cooperate on developing guidance on how to prepare, disseminate and use natural hazard maps.

b. Risk Assessment

18.b.1 When undertaking risk assessments related to hazardous installations, management of should take account of Natech risks.

- Management should be aware of the full spectrum of natural hazards that can affect their installation.

- These assessments should be taken into account in design, siting and operation of hazardous installations as well as in implementing mitigation measures and emergency planning.

18.b.2 Management should use a clear methodology for identification and assessment of Natech risks. In so doing, management should consider:

- analysis, characterisation and probability of relevant natural hazards;
- the potential impact of Natech risks on their processes and facilities;
- the location of hazardous substances in the enterprise and identification of parts the enterprise that might by affected by natural hazards;
- the types of accidents that might be triggered by natural hazards/disasters (including the worst case and most likely cases);

- the possibility of a hazard affecting several parts of an installation at the same time, and the possibility of cascading impacts;
- the fact that multiple hazards may appear at one time (*e.g.*, high winds and rain) and that one natural hazard can trigger another (*e.g.*, an earthquake followed by a tsunami);
- sensitive environments and populations at risk;
- means for reducing risk and improving the inherent safety of the installation;
- an analysis of lessons learned.

18.b.3. Management should be aware, and take account, of the fact that climate change may increase natural hazards. For example, climate change might affect the intensity, frequency and geography of natural hazards. Therefore, management should consider: assessing regional climate change projections; developing an adaptation strategy; implementing enhanced safety measures; and updating assessment and measures as further information becomes available.

18.b.4 Management of existing installations should periodically review their risk assessments, and safety management systems, in light of new information and experience related to natural hazards.

18.b.5 Management should maintain a dialogue with the public authorities with regard to the status of natural hazard assessments such as seismic zone maps and flood risk maps.

c. Risk Management

Design and Construction

18.c.1 Management should take into account natural hazards in the design and construction of hazardous installations.

- In this regard, management should consider whether to incorporate retrofits to existing installations in light of information about natural hazards that was not taken into account in the original design (including, for example, information on additional types of hazards as well as intensity and/or frequency of hazards).

Operation

18.c.2 Management should develop appropriate measures to address natural hazards. For example, special procedures may be needed for extreme meteorological conditions such as heavy precipitation, high winds, and low or high temperatures.

d. Siting and Land-Use Planning

18.d.1 Management should perform a Natech risk analysis before siting a new installation, to identify what location would be the most effective and least expensive approach to Natech risk reduction.

- In addition, site layout should take account of natural hazards (*e.g.*, storage of hazardous substances should not be in areas that are likely to be flooded in the event of a storm).

18.d.2 When establishing land-use planning arrangements and policies related to hazardous installations, public authorities should take into account natural hazards such as floods, extreme temperatures, high winds, earthquakes, and wildfires as well as the possible impacts of climate change.

- Authorities may determine that certain areas, such as flood-prone or earthquake zones, may not be suitable for hazardous installations or may require additional safety measures or more stringent requirements in design, construction and operation.

- Re-assessment of risk zones should be undertaken periodically to take account of new information and experience.

18.d.3 Adequate training in Natech risk management should be provided to those responsible for the siting of installations and land-use planning.

e. Regulations

18.e.1 In developing and reviewing regulations and guidance concerning chemical accident prevention, preparedness and response, public authorities should take into account risks associated with Natechs.

f. Preparedness and Response

Preparedness Planning

18.f.1 Existing emergency plans should be reviewed to be sure they address the possible consequences of earthquakes, floods, extreme temperatures and other natural hazards that might trigger Natechs.

- Emergency planning for natural hazards/ disasters and for chemical accidents should be integrated to address the potential for Natechs. There should be a careful evaluation of relevant natural hazards and Natech risks.

- The planning should take account of worst case and likely case scenarios, as well as possible impacts of climate change on natural hazards.

- Preparedness plans should take into account the impacts that a natural hazard or disaster could have on infrastructure and response capabilities (including, for example, potential impacts on water and power supplies, access routes and communication systems).

Warning Systems

18.f.2 Natural hazard warning systems should be regularly tested, maintained, and updated to inform companies and communities of impending natural hazards or disasters, to the extent practicable.

- The warning systems should incorporate those for tsunamis, as well local weather forecasts (for, *e.g.*, storms, high winds, extreme temperatures).

- Emergency plans should take account of the warning systems that are available and should address what actions should be taken in response to natural hazard warnings.

Response

18.f.3 Response personnel should be provided with available information to be most effective in addressing Natechs.[4]

G. Transboundary Co-Operation

18.g.1 Neighbouring countries should cooperate in Natech prevention, preparedness and response including:

- identification of natural hazards that may cause Natech risks in one country or across international borders;
- drafting and communication of natural hazard maps;
- establishment, maintenance and improvement of natural hazard warning systems;
- development, enforcement and improvement of methodologies and requirements for Natech risk management; and
- emergency planning and response including mutual assistance.

18.g.2 Countries should exchange experience concerning good practices for Natech prevention, preparedness and response including natural hazard identification, hazard mapping and natural disaster management.

H. Polluter Pays Principle

18.h.1 Countries should consider how to apply the Polluter Pays Principle in the context of chemical accidents triggered, or made worse, by natural hazards.

- The 1988 OECD Recommendation on the Polluter Pays Principle provides an exception for accidents caused by a "serious natural disaster that the operator cannot reasonably have foreseen". Countries should consider how to interpret this provision in light of known natural hazards.

[4] The Hazard Identification Tool (HIT) and Flash Environmental Assessment Tool (FEAT), developed by UNEP and OCHA as support tools for first responders to raise awareness of the need to identify and address secondary environmental risks as early as possible in the event of a natural disaster and as a basis for on-site interventions can serve as examples of good practice to respond to Natechs.

ANNEXES

Annex I. Explanation of Terms Used (pages 177 – 182)

Addition of a definition of a Natech

> **Natech:** A chemical accident, including spills of oil and oil products, triggered by a natural hazard or natural disaster (such as extreme temperatures, high winds, floods, storms, earthquakes, or wildfires).

Annex IV: Selected References (pages 197 – 206)

PUBLICATIONS

General

Nijenhuis R., E. Wahlstrom (2014), *The Use of the Flash Environmental Assessment Tool in Developing Countries*, Journal of Environmental Assessment Policy and Management, Vol. 16, No. 3 (September 2014), DOI: 10.1142/S1464333214500264

Posthuma L., E. Wahlstrom (2014), *The Flash Environmental Assessment Tool: Worldwide first aid for chemical accidents response, pro action, prevention and preparedness*, Environment International, in press

OECD (2013), Report of the Workshop on Natech Risk Management (23-25 May 2012, Dresden, Germany), Series on Chemical Accidents No. 25, ENV/JM/MONO(2013)4, http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2013)4&doclanguage=en

UNEP (2008), Assessing the Vulnerability of Local Communities to Disasters- An Interactive Guide and Methodology, http://apell.eecentre.org/Modules/GroupDetails/UploadFile/CommunityRiskProfile.pdf

UNEP (2010), APELL Multi-Hazard Training Kit for Local Authorities- For Community Vulnerability Reduction, Prevention and Preparedness, http://apell.eecentre.org/Modules/GroupDetails/UploadFile/APELL_Multi-Hazard_Training_Kit_Summary.pdf

Krausmann E., D. Baranzini (2012), Natech risk reduction in the European Union, Journal of Risk Research 15(8), 1027-1047.

Krausmann E., V. Cozzani, E. Salzano, E. Renni (2011), *Industrial accidents triggered by natural hazards: an emerging risk issue*, Natural Hazards and Earth System Sciences 11 (2011) 921–92

Krausmann E. (2010), Analysis of Natech risk reduction in EU Member States using a questionnaire survey, EUR Report 24661 EN, European Union, 2010

Krausmann E., D. Baranzini (2009), Natech risk reduction in OECD Member Countries: Results of a questionnaire survey, JRC Report 54120, European Communities, limited distribution

Prevention

Cruz A.M., E. Krausmann (2013), *Vulnerability of the oil and gas sector to climate change and extreme weather events*, Special Issue "Climate Change, Extremes, and Energy Systems, Climatic Change 121 (2013) 41-53

Krausmann E., E. Renni, V. Cozzani, M. Campedel (2011), *Major industrial accidents triggered by earthquakes, floods and lightning: Results of a database analysis*, Natural Hazards 59/1 (2011) 285-300

Hazard and Risk Assessment

Girgin S., E. Krausmann (2013), *RAPID-N: Rapid Natech risk assessment and mapping framework*, Journal of Loss Prevention in the Process Industries 26 (2013) 949-960.

Girgin S., E. Krausmann (2013), Case-study application of RAPID-N, JRC Technical Report 87220, European Commission, Joint Research Centre

OECD WORKSHOPS and SPECIAL SESSIONS related to CHEMICAL ACCIDENTS

Workshop on Natech Risk Management (23-25 May 2012, Dresden, Germany), report published in 2013 as OECD Environment Monograph No.25.

LEGAL INTRUMENTS

EC Directive

Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC, Official Journal of the European Union, L 197/1.