Unclassified **ENV/JM/MONO(2013)4**

Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development **18-Jan-2013**

English - Or. English

ENV/JM/MONO(2013)4
Unclassified

ENVIRONMENT DIRECTORATE
JOINT MEETING OF THE CHEMICALS COMMITTEE AND
THE WORKING PARTY ON CHEMICALS, PESTICIDES AND BIOTECHNOLOGY

REPORT OF THE WORKSHOP ON NATECH RISK MANAGEMENT (23-25 May 2012, Dresden, Germany)

Series on Chemical Accidents
No. 25

JT03333454

English - Or. English

OECD Environment, Health and Safety Publications

Series on Chemical Accidents

No. 25

REPORT OF THE WORKSHOP ON NATECH RISK MANAGEMENT
23-25 May 2012, Dresden, Germany

IOMC

INTER-ORGANIZATION PROGRAMME FOR THE SOUND MANAGEMENT OF CHEMICALS

A cooperative agreement among **FAO, ILO, UNDP, UNEP, UNIDO, UNITAR, WHO, World Bank and OECD**

Environment Directorate

ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT

Paris 2013

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

Report of the OECD Workshop on Strategies for Transporting Dangerous Goods by Road: Safety and Environmental Protection (1993)

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]

Guidance Concerning Health Aspects of Chemical Accidents. *For Use in the Establishment of Programmes and Policies Related to Prevention of, Preparedness for, and Response to Accidents Involving Hazardous Substances* (1996)

Report of the OECD Workshop on Small and Medium-sized Enterprises in Relation to Chemical Accident Prevention, Preparedness and Response (1995)

Guidance Concerning Chemical Safety in Port Areas. *Guidance for the Establishment of Programmes and Policies Related to Prevention of, Preparedness for, and Response to Accidents Involving Hazardous Substances. Prepared as a Joint Effort of the OECD and the International Maritime Organisation (IMO)* (1996)

OECD Series on Chemical Accidents:

No. 1, Report of the OECD Workshop on Risk Assessment and Risk Communication in the Context of Chemical Accident Prevention, Preparedness and Response (1997)

No. 2, Report of the OECD Workshop on Pipelines (Prevention of, Preparation for, and Response to Releases of Hazardous Substances (1997)

No. 3, International Assistance Activities Related to Chemical Accident Prevention, Preparedness and Response: Follow-up to the Joint OECD and UN/ECE Workshop to Promote Assistance for the Implementation of Chemical Accident Programmes (1997)

No. 4, Report of the OECD Workshop on Human Performance in Chemical Process Safety: Operating Safety in the Context of Chemical Accident Prevention, Preparedness and Response (1999)

No. 5, Report of the OECD Workshop on New Developments in Chemical Emergency Preparedness and Response, Lappeenranta, Finland, November 1998 *(*2001)

No. 6, Report of the OECD Expert Meeting on Acute Exposure Guideline Levels (AEGLs) (2001)

No. 7, Report of the Special Session on Environmental Consequences of Chemical Accidents (2002)

No. 8, Report of the OECD Workshop on Audits and Inspections Related to Chemical Accident, Prevention, Preparedness and Response (2002)

No. 9, Report of the OECD Workshop on Integrated Management of Safety, Health, Environment and Quality, Seoul, Korea, 26 - 29 June 2001 (2002)

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)

No. 15, Integrated Management Systems (IMS)-Potential Safety Benefits Achievable from Integrated Management of Safety, Health, Environment and Quality (SHE&Q) (2005)

No. 16, Report of the OECD-EC Workshop on Risk Assessment Practices for Hazardous Substances Involved in Accidental Releases, 16-18 October 2006, Varese, Italy (2007)

No. 17, Report of Survey on the Use of Safety Documents in the Control of Major Accident Hazards (2008)

No. 18, Guidance on Developing Safety Performance Indicators for Public Authorities and Communities/ Public (2008, revision of the first edition published in 2003)

No. 19, Guidance on Developing Safety Performance Indicators for Industry (2008, revision of the first edition published in 2003)

No. 20, Report of the OECD-CCA Workshop on Human Factors in Chemical Accidents and Incidents, 8-9 May 2007, Potsdam, Germany (2008)

No. 21, Report of the OECD Workshop on Safety in Marshalling Yards, 15-16 October 2007, OECD, Paris, France (2008)

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)

No. 24 Corporate Governance for Process Safety - Guidance for Senior Leaders in High Hazard Industries *(2012)*

About the OECD

The Organisation for Economic Co-operation and Development (OECD) is an intergovernmental organisation in which representatives of 34 industrialised countries in North and South America, Europe and the Asia and Pacific region, as well as the European Commission, meet to co-ordinate and harmonise policies, discuss issues of mutual concern, and work together to respond to international problems. Most of the OECD's work is carried out by more than 200 specialised committees and working groups composed of member country delegates. Observers from several countries with special status at the OECD, and from interested international organisations, attend many of the OECD's workshops and other meetings. Committees and working groups are served by the OECD Secretariat, located in Paris, France, which is organised into directorates and divisions.

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

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

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

This publication is available electronically, at no charge.

For this and many other Environment,
Health and Safety publications, consult the OECD's
World Wide Web site (www.oecd.org/ehs/)

or contact:

OECD Environment Directorate,
Environment, Health and Safety Division
2 rue André-Pascal
75775 Paris Cedex 16
France

Fax: (33-1) 44 30 61 80

E-mail: ehscont@oecd.org

FOREWORD

This document contains the report of the *Workshop on Natech Risk Management* (Natural-hazard triggered technological accidents). This workshop was held on the 23^{th}-25^{th} May 2012, in Dresden, Germany.

The historical background of the activity is briefly described below.

A project on chemical accidents caused by natural hazards has been included in the 2009-2012 Programme of Work and Budget (PWB) of the OECD Chemicals Accidents Programme. The aim was not to initiate a major activity in this area, but rather to identify whether there are specific elements in terms of emergency preparedness and response to chemical releases resulting from natural disasters, which are not part of national chemical accidents programmes or addressed in OECD's Guiding Principles for Chemicals Accidents, Prevention, Preparedness and Response. A Steering Group on Natech (SG-Natech) was established in 2008, led by Germany, to work on the development of best practices for the control of the impact of natural hazards on chemical installations.

The draft report was launched at a Conference held on 23^{th}-25^{th} May, 2012 in Dresden, Germany. The event was sponsored and hosted by the Federal Ministry for the Environment of Germany (BMU) and the Government of Saxony. The workshop report was prepared by Germany in consultation with the SG-Natech and the OECD Secretariat.

The WGCA endorsed this document [ENV/JM/ACC(2012)2], with some amendments, at its 22^{nd} Meeting on 17^{th}-19^{th} October 2012. It then agreed to forward this document to the Joint Meeting with a request for its declassification.

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

INTRODUCTION

1. The OECD Programme on Chemical Accidents works to develop guidance on prevention of, preparedness for, and response to chemical accidents. It facilitates the sharing of information and experiences of OECD members, and non-member economies and other stakeholders. The Programme is managed by the Working Group on Chemical Accidents (WGCA).

2. A project on chemical accidents caused by natural hazards has been has been part of the 2009-2012 Programme of Work and Budget (PWB) of the OECD Chemical Accidents Programme. The objectives of the Natech (Natural-hazard triggered technological accidents) project were to: (i) investigate the specific elements of prevention of chemical releases as well as preparedness for and response to chemical releases resulting from the impact of natural hazards, which are not part of the national chemical accidents programmes; and (ii) make recommendations for good practices with respect to prevention of, preparedness for and response to Natech accidents.

3. The work started in 2008 under the auspices of the Working Group on Chemical Accidents (WGCA) with the establishment of a Steering Group on natural-hazard triggered technological accidents (SG-Natech) to work on the development of best practices for the control of the impact of natural hazards on chemical installations. Germany is the lead country for this project. The SG-Natech was composed of representatives of: the Czech Republic, France, Germany (chair), Korea, Switzerland, Turkey, the United Kingdom, United States, the European Commission, UNEP and the OECD Secretariat.

OECD-EC SURVEY ON NATECH RISK REDUCTION

4. The SG-Natech began its activities by preparing a questionnaire for an OECD-EC survey of Natechs that was conducted in 2009. The purpose of the survey was to collect information to assess: (i) the risk management policies at national and international levels relating to chemical accidents caused by natural hazards; and (ii) the current activities, research and publications on natural hazards, their impact on industrial installations and the related preparedness and mitigation measures. The survey report was prepared by the Joint Research Centre (JRC)- of the European Commission (EC) Institute for the Protection and Security of the Citizen (IPSC)[1].

5. The survey report analysed the responses received and proposed conclusions on the following topics: (i) Natech events data collection and retrieval; (ii) learning from Natechs; (iii) Natech awareness and risk reduction; and (iv) identified needs and limitations in Natech risk reduction. It also presented overall conclusions concerning the need for improvement of existing regulations, the perception/awareness of Natech risk and the implementation of Natech risk reduction measures. Finally it made recommendations for further work in developing a strategy to implement an existing framework for Natech risk reduction in order to make it (more) effective.

6. Under the auspices of the WGCA, the SG-Natech organised a *Workshop on Natech Risk Management* held on 23-25 May 2012, in Dresden, Germany. The event was sponsored and hosted by the Federal Ministry for the Environment of Germany (BMU) and the Government of Saxony.

WORKSHOP ON NATECH RISK MANAGEMENT

Objective and Scope

7. The overall objective of the workshop was to investigate the specific elements of the prevention of, preparedness for and response to chemical accidents caused by a natural hazard or natural disaster – for example, flood, storm, landslide, earthquake, volcanic eruption – and to make recommendations for best practices related to Natechs.

---

[1] *Natech risk reduction in OECD member countries: Results of a questionnaire survey* (2009) by Elisabeth Krausmann and Daniele Baranzini, JRC Scientific and Technical Reports, No. 54120, European Communities, 2009 (limited distribution).

8. The scope of the workshop included any fixed chemical installation where hazardous substances are produced, processed, used, handled, stored, transported or disposed of, with potential risk for fire, toxic release, explosion, spill, etc. Other sectors of industrial activity were considered with respect to transfer of knowledge and experience.

Programme

9. The Programme of the *Workshop on Natech Risk Management* is presented in Annex 1. The workshop consisted of five sessions, each with a panel of speakers addressing the topic of the session from different perspectives, and discussing relevant issues as follows:

Opening:	Welcome – Opening speech(es) – Presentation of Discussion Document
Session I:	Natural hazards: risk mapping and warning systems
Session II:	Natech risk management, including emergency planning – Good practices of industry and public authorities
Session III:	Considering climate change in Natech risk management
Session IV:	Application of the Polluter-Pays-Principle to Natech accidents
Session V:	International cooperation on Natech risk management
Closing:	Conclusions and Recommendations

Session I: Natural hazards: risk mapping and warning systems

10. This session addressed the duties of authorities fundamental for Natech risk management, including how to analyse natural hazards and risks, how to communicate about hazards and risks with the relevant people and how to set up effective warning systems. The focus was on natural hazards which can be geographically localised (for example, floods, rock falls and avalanches). The discussion concentrated on the different possibilities to illustrate various parameters relevant for natural hazard maps such as magnitudes (intensity or severity) or frequencies (probability of occurrence or return period) and on how to map resulting risks. These rather technical aspects were complemented by organisational and communication aspects in relation to land use planning and warning systems. An additional topic addressed at this session was the mapping of risks of Natech accidents.

Session II: Natech risk management, including emergency planning – Good practices of industry and public authorities

11. This session examined strategies, approaches and good practice for Natech risk management. This included the consideration of Natechs in "conventional" industrial risk management and existing regulations, technical codes and guidelines as well as the development of dedicated approaches. In addition, the session discussed the raising of awareness on Natechs, clarifying roles and responsibilities, consideration of Natechs in land-use- and emergency-planning, as well as a need for specific training on Natech risk. The final aim of the session was the identification of success stories as well as research gaps and shortcomings in strategies, regulations, codes, guidance and practices for Natech risk management.

Session III: Considering climate change in Natech risk management

12. This session explored: (i) what is known about the effects of climate change on the frequency, intensity and geographical extent of natural hazards which can lead to chemical accidents; (ii) which strategies for adaptation to climate change exist and how far they take changes to chemical safety due to climate change into consideration; and (iii) how climate change adaptation can be integrated into policies on Natech prevention, preparedness and response.

Session IV: Application of the Polluter-Pays-Principle to Natech accidents

13. This session aimed at clarifying the responsibilities of the operators and authorities with respect to Natech accidents. In this regard the OECD Recommendation on the application of the Polluter-Pays-Principle (PPP) to

accidental pollution was considered. This instrument contains an Appendix on "Guiding Principles relating to Accidental Pollution". The issue of liability of operators was discussed in cases of accidental pollution resulting from the impact of natural hazards on chemical installations and the application of PPP to Natech accidents.

Session V: International cooperation on Natech risk management

14. This session took an in-depth look into challenges at the international level concerning the tools, practices and governance frameworks supporting the provision of multilateral assistance to Natechs. It also provided an overview of a number of current initiatives undertaken to address these challenges. The session discussed the various roles that regional and international organisations can play in the emergency response system, as well as those of local authorities and the private sector.

Discussion Document

15. A Discussion Document was distributed to workshop participants. The Discussion Document provided an overview of the Natech topic, identified areas where there appears to be a general consensus and areas where there remains differing opinions or approaches. It also suggested issues for discussion. Moreover, the Discussion Document gave examples of good practices.

Presentations

16. The speakers' presentations are presented in Annex 2.

Participation

17. The workshop brought together representatives of central government (including safety, civil protection, spatial planning and environment bodies), local authorities, non-governmental organisations, international organisations, industry and academia. There were 80 participants from 22 delegations including non-member economies from the Philippines, Romania and Sri Lanka. The UNECE, UNEP and BIAC were also present. The list of participants is provided in Annex 3.

Conclusions and Recommendations

General conclusions and recommendations from the overall Workshop

18. The definition used at the Workshop for Natech accidents – **Na**tural hazard triggered **tech**nological accident – was:

> *A 'Natech' accident is a chemical accident caused by a natural hazard or a natural disaster. Chemical accidents include accidental oil and chemical spills, gas releases, and fires or explosions involving hazardous substances from fixed establishments (such as petrochemical, pharmaceutical, pesticide, storage depot), as well as oil and gas pipelines.*

19. Natech accidents have occurred in several OECD member countries. It was recommended that awareness of Natech risks should be enhanced in governments/competent authorities, industry, NGO´s, and communities; furthermore that Natech risk communication should be improved.

20. Natech risks should be taken into consideration in the regulations related to chemical accident prevention, preparedness and response. Risk management at hazardous facilities should integrate Natech risks, for example in process risk analysis, implementation of prevention, preparedness and response measures, development of safety documents and emergency management plans. Natech accident data should be collected and used to support the development – or improvement – of regulations and guidance for Natech risk reduction.

21. Due to the predicted increase in severity of some natural disasters (*such as* hydrometeorological events), consideration of Natech risks is becoming more relevant for decisions related to the siting of hazardous facilities and land-use-planning.

22. Methods and tools for Natech risk analysis and risk mapping should be improved and better applied. Guidance on Natech risk management for operators, authorities and communities should be developed or further improved.

Conclusions and Recommendations from Session I

Natech risk mapping

23. It was recognised that natural hazard maps are important tools for the dissemination of information on natural hazard risks. The development of natural hazard maps needs reliable data on the probability and intensity of the natural hazards in the region covered.

24. It was also noted that European regulation and technical guidance on flood hazard maps, the website of natural hazard maps developed in Switzerland and Saxony, and the presented interactive GIS-based systems are examples of good practices.

25. Governments should be aware of their responsibility with regard to natural hazard maps. This includes the collection of data and the development of natural hazard maps including updating as appropriate as well as the dissemination of information they contain. If threatened by the same natural hazard, neighbouring countries should work together in the development of natural hazard maps.

26. Natural hazard maps should address all types of hazards that may cause chemical accidents. In this regard, the data availability and methodologies need to be improved. Natural hazard and Natech risk maps are useful for water management, land use planning, disaster and emergency planning. They also have value for insurers.

27. There is a need for guidance on developing natural hazard maps at national and international level. Stakeholders should carefully consider the types of natural hazard covered by a map. They should also be aware that hazard maps may contain both deterministic and probabilistic information when interpreting it.

28. Adequate training should be provided to those responsible for drafting and using natural hazards maps, for example in siting of installations, land-use-planning, licensing, implementation of prevention, preparedness and response measures.

Warning systems

29. All warning systems are based on the following elements: (i) Instrumentation; (ii) Computer-based analysis and forecasting; (iii) Evaluation of information with dissemination of warnings; and (iv) Response capability.

30. The earthquake forecast and warning systems in Mexico, California, Turkey and Japan are examples of good practices. They are all built on the local geological conditions. Their application to other threatened areas cannot be brought into general use. Therefore adjustment to the local geological conditions is always necessary. In case of earthquakes, for which the warning time is extremely short (typically a few seconds), the risk of false alarm is relatively high. Earthquake forecast and warning systems should be improved in order to increase the warning time and reduce the number of false alarms.

31. The warning time is much longer for tsunamis and floods. Examples of good practices for tsunami forecast and warning systems are established for the Pacific Ocean, Indian Ocean, North Eastern Atlantic, Mediterranean Sea and the Caribbean. There are also good examples of best practices on the internet for flood forecast and warning systems in Germany.

32. A good example of a local warning system for extreme hydrometeorological events has been developed in the framework of the 'Safe' research project in Germany. Weather data from global forecasting models is combined with local weather information and translated into local-specific weather prognosis. Warning messages for subscribers are generated by comparing the subscribers’ location and their warning request profiles with actual warnings issued by the meteorological component.

33. Warning systems are useful for Natech risk reduction. Member countries and non-member economies should develop warning systems, especially for river basins that have a high industry density.

34. Local forecast systems for hydrological events provide useful input to warning systems and these should be applied in industrial areas such as those threatened by flash floods.

Session II – Natech risk management – Good practices of industry and public authorities

35. Natech risk can be more important than non-natechrisk for example by technical failure. A natural-hazard trigger can have a higher occurrence frequency than the trigger of a “conventional accident” and a natural hazard can affect several installations or facilities at the same time and consequently cause several chemical accidents at the same time.

36. Natech risks should be at an "acceptable level"; which requires an analysis of Natech risks. If there is the same risk level in different facilities, lower probabilities have to be achieved by sites, facilities or groups of them with a larger damage potential in case of a Natech event.

37. Natech risk management should encompass pipelines, on-site transport and transport interfaces.

Risk Analysis and Management

38. Natural hazard considerations should be part of industrial risk management. Operators should include Natech risks in their risk analysis. Operators should perform this analysis before siting a new facility because a decision for another location might be the most effective and less expensive approach to Natech risk reduction. Likewise operators of existing installations should review their risk management in light of natural hazard and climate change aspects. The aim of the analysis is to determine appropriate prevention, preparedness and response measures in order to reduce the risks of Natechs to an acceptable level. It should be noted that the analysis of risks due to technical and/or human failures and the related risk analysis methodology may not cover risks due to natural hazards.

39. The analysis of risk related to natural hazards may include the following elements:

a) Analysis and characterization of relevant natural hazards including possible effects of climate change.

b) Analysis of Natech risks related to process and facility: (i) analysis of lessons learned including local experience from former natural events; (ii) identification of parts of a facility which may be affected by natural hazards; and (iii) analysis of impact of natural hazards, *e.g.*: (a) analysis of hazardous properties of substances and mixtures; (b) analysis of equipment behaviour; (c) analysis of the impact of loss of supply means; and (d) impact on safety measures;

c) Elaboration of a safety (protection) plan: (i) definition of safety or protection targets; (ii) definition of prevention measures, *e.g.* required safety barriers; and (iii) evaluation of compliance with the safety or protection targets; and

d) Analysis of remaining risks and definition of preparedness and response measures: (i) analysis of major accident scenarios; (ii) determination of mitigation measures; and (iii) emergency planning (internal/external).

40. In this context it should be considered that:

a) One natural hazard can cause several kinds of hazardous impacts, for example a flood may cause loading due to strong currents and floating debris;

b) One natural hazard can trigger others, for example an earthquake followed by a tsunami;

c) Several natural hazards may appear at the same time, for example rain and lightning, heavy precipitation and flooding;

d) A natural hazard can simultaneously impact several parts of an installation or facility;

e) One natural hazard can affect several installations or facilities at the same time;

f) Larger quantities of hazardous substances may be released following a natural hazard than in an accident resulting from technical failure, such as the loss of containment of several tanks at the same time;

g) The extent to which one natural impact can trigger another impact at another facility, installation or a different part of the same installation should be investigated;

h) The mitigation barriers established for scenarios developed based on technical causes may not be effective in case of Natechs. The availability of mitigation measures will be limited in case of extreme natural events (because of damage to access routes, disruption of energy and water supply, communication difficulties, etc.). Likewise, the availability of external personnel will be limited; and

i) In the case of floods, the dispersion of substances in the atmosphere and water has to be taken into account in the accident scenarios including possible secondary scenarios due to reaction with water.

41. Methods/tools for Natech risk analysis – possibly deriving from existing 'conventional' risk analysis methods for industrial facilities – should be developed and implemented; however this is an area where further research and development is needed.

42. The identification and characterization of relevant natural hazards can start with the consultation of natural hazard maps. A scenario-based detailed analysis of all natural hazards that can affect a site should be established. An interdisciplinary approach to the definition of reference scenarios for natural events is needed. Operators should ascertain that they are aware of the full spectrum of natural hazards – including the intensity and probability – that can affect their site.

43. Natech risk analysis should both consider the probability and intensity of hazardous natural events, the timescales of development and the geographical extent (for example, precipitation run-off models and wildfire models).

44. Operators should check carefully for which natural events and their evolution, warning systems are designed, operated and effective. Procedures should be in place on how to react in case of a natural hazard warning.

45. Natural hazards may cause (primary) accidents which are not captured in the 'conventional' risk analysis; Natech accidents can initiate 'cascading effects'. A scenario-based analysis of the propagation of Natech events is useful (for example, by using a bow-tie approach). The analysis should consider the failure of technical and organizational measures for prevention of damage in the case of Natechs.

Safety or Protection Targets

46. Operators are responsible for managing the risks related to their facilities including Natech risks. They should not only rely on protection measures against natural hazards provided by authorities.

47. It is not required that installations remain operational during or after the impact of a natural hazard, except the "critical infrastructure"; the safety-critical parts of an installation, like cooling and fire fighting systems, have to stay operational or their functions have to be guaranteed through other measures. Consequently some (safety-critical) parts of installations may require a higher level of protection against the impact of natural hazards.

48. Industrial facilities may have design requirements different from those of buildings destined for public use. Design criteria for the prevention of damage by natural hazards to 'conventional' (non-industrial) buildings may not be suitable for hazardous industrial installations. Different design criteria may be required to account for the different design objectives (guaranteeing of life safety *vs.* avoiding chemical accidents such as the loss of containment causing releases of large quantities of hazardous substances). Increased minimum criteria for prevention measures like design criteria that may be combined with adequate time for retrofitting of existing installations.

49. The evaluation of compliance with the safety/protection targets should consider that protecting against the worst case is not always too difficult or expensive. Defined safety targets – like in the United Kingdom ALARP principle (As Low As Reasonably Practicable) – have to be applied to Natech risk management.

Preparedness and Response

50. The development of specific Natech major accident scenarios may help to develop adequate preparedness and response measures and establish appropriate emergency planning.

51. A specific Natural Disaster Response Plan may be useful and should be based on the careful evaluation of all possibilities to mitigate the effects of Natech accidents.

52. Special operational procedures may be needed for extreme meteorological conditions, for example, freezing conditions or high wind speeds.

53. Safety documents should consider the aspect of training staff to coordinate all activities in case of an extreme natural event. This includes cooperation with the local authorities, first responders and possible other organisations. If necessary, the authorities should coordinate transboundary activities for example dissemination of information or transboundary aid.

Session III – Consideration of climate change in Natech risk management

54. Companies should be aware that climate change is a business risk. Costs for adaptation can be significant; however costs of not addressing natural hazards can be major and investors are already looking for evidence of adaptation measures. Enterprises should therefore consider climate change projections in the investment cycle.

55. Climate change is likely to affect the intensity, frequency and geographical occurrence of a range of natural hazards, including: extreme temperatures, sea level, extreme precipitations, flooding, coastal/ river erosion, storms, lighting, droughts as well as wild and forest fires.

56. Average and maximum temperatures have increased over the last few decades. Climate change modelers are confident with projections which show there will be a global temperature rise. This does not exclude that in some regions there will be a decrease of average and extreme temperatures. There is less confidence in projections for extreme precipitation events.

57. Facilities already subject to hydrometeorological events may be the most vulnerable. For example, much of the major oil and gas infrastructure is located in low lying areas and is therefore vulnerable to storm surges, flooding and hurricanes/typhoons. Facilities near river basins and large water bodies may be subject to increasing flood loads and associated hazards over the next 50 years. Re-assessment of flood prone zones is therefore required to take account of climate change projections.

58. New national legislation addressing Natechs should take climate change aspects into account. An example of good practice is the German technical rule for process safety: prevention and preparedness related to precipitation and floods hazards.

59. The consideration of climate change in Natech risk management should be part of the climate change adaptation process of an enterprise. This should include: (i) an assessment of (regional) climate change projections; (ii) the development of an adaptation strategy; (iii) the implementation of enhanced measures; and (v) the updating of assessment and measures following climate change projections including updating of Natech risk management.

60. Emergency plans for hydrometeorological events need regular updating. Operators should consider climate change worst-case scenario for their facilities in the same way as they develop worst-case scenarios for 'conventional' accidents. Some enterprises have started to address the climate change issue in developing programmes that include the management of Natech risks.

61. Guidance would be helpful at international level for considerations of climate change in the siting of new installations[2] for authorities, enterprises and communities.

Session IV – Application of the Polluter-Pays-Principle to Natech accidents

62. Some chemical accidents causing environmental damage are Natechs, that is, they are caused by natural disasters.

63. Damages resulting from chemical accidents triggered by natural hazards fall under the tort law[3], the Polluter-Pays-Principle (PPP), and the property law. The approach opposed to the application of the PPP is the compensation of damage by governments and financed by taxes.

64. The OECD recommendations related to PPP[4] allow for an exemption from strict liability if accidents are caused by natural disasters, *e.g.* one criterion for the exemption from strict liability is the "uncontrollability" of the impacts caused by the natural disasters (*e.g.* in case of effects due to a strong earthquake). But it is not clear whether this is an argument pro or contra strict liability.

65. There is also liability in the case of violation of standards in force.

66. Addressing gaps in liability is desirable. The exemption related to Natech accidents in the OECD *Recommendation Concerning the Application of the Polluter Pays Principle to Accidental Pollution*[5] is a case point. The polluter should be responsible even if the causes of a Natech accident were unforeseeable, irresistible and inevitable, however the chemical accident caused was foreseeable and damages should be covered by insurance. However the liability insurance limits often are too low; insurance limits should be sufficient to cover the risk caused by a facility and should take 'pure' environmental damage into account.

67. The OECD should encourage the application of the Polluter-Pays-Principle with a wider scope, and re-consider the exemption related to the application of the PPP in case of Natechs.

68. If OECD member countries apply exemptions in liability for damage caused to the environment in case of Natechs caused by an unforeseeable, irresistible and inevitable natural event, the following rules should apply:

- A Natech was unforeseeable if the kind of underlying natural event was not regarded as possible or if the underlying natural event had a severity above that regarded as possible according to scientific knowledge, especially if the effects of the natural event were above those of the most intense event recorded under similar conditions (for example, same location) or expected change of conditions (such as change in land use, climate change).

---

2 See: Center for Chemical Process Safety: Guidelines for Facility Siting and Layout, Wiley August 2003 (update intended)

3 Definition of 'Tort Law' (as used in the Natech-workshop): The concept of tort law is to redress a wrong done to a person, usually by awarding them monetary damages as compensation.

4 OECD Recommendation (1972) on Guiding Principles Concerning International Economic Aspects of Environmental Policies [C(72)128].

OECD Recommendation (1974) on the Implementation of the Polluter Pays Principle [C(74)223].

OECD Recommendation (1989) Concerning the Application of the Polluter Pays Principle to Accidental Pollution [C(89)88].

5 OECD Council Recommendation on the Application of the Polluter-Pays Principle to Accidental Pollution [C(89)88/Final], article 7 states: *"If the accidental pollution is caused solely by an event for which the operator clearly cannot be considered liable under national law, such as a serious natural disaster that the operator cannot reasonably have foreseen, it is consistent with the Polluter-Pays Principle that public authorities do not charge the cost of control measures to the operator."*

- A Natech was irresistible if the underlying natural event had such impacts that it was not possible to foresee the chemical accident caused or to mitigate its consequences.

- A Natech was inevitable if it was not possible to prevent the chemical accident or mitigate its consequences.

Session V – International Co-operation on Natech Risk Management

International projects

69. OECD should encourage the exchange of experience within the OECD member and non-member economies, including the application of good practices for natural hazard identification and natural disaster management.

70. The UNEP's *Flexible Framework for Addressing Chemical Accident Prevention and Preparedness* is a useful tool that can be applied to Natech risk management. The UNEP Programme on Awareness and Preparedness for Emergencies at Local Level (APELL) is a useful tool for site-specific Natech risk management.

71. Natech risk management is part of the legally binding UNECE Convention on the Transboundary Effects of Industrial Accidents (TEIA); capacity-building is a key component of the assistance programme.

72. Transboundary impacts of Natechs should be duly taken into consideration, and cross-border cooperation in Natech risk management (including mutual assistance) should be promoted.

73. The main international actors/stakeholders should cooperate more closely and make a better use of one another products. This will include, amongst other things: the EC-JRC Report on *Natech risk reduction in OECD member countries: results of a questionnaire survey*, and information platforms – such as the UNEP-OCHA Advisory Group on Environmental Emergencies (AGEE). Stronger co-ordination and exchange of information should be encouraged.

International assistance

74. With the Intervention in Chemical Transport Emergencies (ICE), CEFIC provides an example of good practice in the cooperation between authorities and industry in response to chemical transport accidents. The potential use of ICE resources for transport accidents outside its members should be further explored.

75. A multi-stakeholder approach, including coordination between governments, is important for Natech risk management.

76. The Hazard Identification Tool (HIT) and the Flash Environmental Assessment Tool (FEAT), developed by UNEP and OCHA are examples of good practice to respond to Natech accidents. The potential of these tools to assist countries in Natech risk management should be further developed, making the best use of the existing tools and countries' expertise. The UNEP-OCHA Environmental Emergency Center could be used as platform for capacity development and information share.

Recommendations for further work

77. The Natech Workshop made the following recommendations on the need for:

- Development of guidance – at national or international level – for preparing natural hazard maps so that maps from various sources be properly understood by all stakeholders;

- Evaluation of good practice in natural hazard forecast and warning systems (for example, forecast and warning systems for local extreme weather, floods or earthquakes) and dissemination of information about their effectiveness;

- Development of guidance on the consideration of natural hazards in the siting of installations and facilities, including the effects of climate change;

- Improvement of Natech risk analysis methodologies as well as guidance on their application;

- Development of guidance on Natech risk management;

- Identification of best practices for Natech risk reduction;

- Revision of the OECD Council Recommendation on the Application of the Polluter-Pays Principle to Accidental Pollution [C(89)88/Final] and in particular, article 7, which states: *"If the accidental pollution is caused solely by an event for which the operator clearly cannot be considered liable under national law, such as a serious natural disaster that the operator cannot reasonably have foreseen, it is consistent with the Polluter-Pays Principle that public authorities do not charge the cost of control measures to the operator*."; and

- Strengthening international cooperation on prevention of, preparedness for and response to Natech accidents by making better use of all tools available.

ANNEX 1

PROGRAMME

Tuesday, 22 May, 2012				
14:00	16:00			Excursion to the site of Fluorchemie Dohna (site threatened by flashfloods)
16:00	20:00			Registration, distribution of badges and workshop documents
18:00	19:00			Meeting of chairs, speakers, rapporteurs, consultant Roland FENDLER (Federal Environment Agency (UBA), Germany)
Wednesday, 23 May, 2012				
08:00	09:00			Registration, distribution of badges and workshop documents
09:00	10:00			OPENING SESSION: Welcome & Introduction
				Ruth OLDENBRUCH (Federal Ministry for the Environment, Germany)
				State Secretary Dr. Fritz JAECKEL (Minister for the Environment and Agriculture, Free State of Saxony)
				Marie-Chantal HUET (OECD)
09:15	09:30			Natech Risk reduction in OECD member countries: Results of a survey Elisabeth KRAUSMANN (EC Joint Research Center)
09:30	10:00			Presentation of the Discussion Document Karl-Erich KÖPPKE (Consultant, Dr. Köppke GmbH, Germany)
10:00	**13:30**			SESSION I: Natural Hazards: Risk Mapping and Warning Systems Chair: Georg BÖHME-KORN (Saxon State Ministry of the Environment and Agriculture) Rapporteur: Daniel BONOMI (Federal Office for the Environment (FOEN), Switzerland)
10:00	10:40			Natural Hazard Mapping
			I.1	Hazard and risk maps as a main element of flood risk management: lessons learnt after 2002 flood in Saxony Martin SOCHER (Saxon State Ministry of the Env. & Agriculture)
			I.2	Principles of risk management for natural hazards: The case of Switzerland Hans KIENHOLZ (KiNaRis, Switzerland)
10:40	11:00			Discussion
11:00	11:30			Coffee Break

11:30	12:10			Natech Risk Mapping
			I.3	Use of GIS and conceptual mapping in identification and monitoring of Natech risks Aleksandar JOVANOVIC (European Virtual Institute for Integrated RM)
			I.4	RAPID-N Tool for mapping Natech risk due to earthquakes Serkan GIRGIN (EC Joint Research Center)
12:10	12:30			Discussion
12:30	13:10			Warning Systems
			I.5	SAFE: An example of an extreme weather hazard warning system for communities and industries Ulrich MEISSEN (Fraunhofer Inst. Open Communication Systems, Germany)
13:10	13:30			Discussion
13:30	14:30			Lunch
14:30	19:00			SESSION II: Natech risk management – Best practices of industry & authorities Chair: Christian JOCHUM (European Process Safety Center) Rapporteurs: Elisabeth KRAUSMANN/ Agnes VALLEE/ Roland FENDLER (EC JRC/ INERIS, France/ UBA, Germany)
14:30	16:10			Flood Risks
			II.1	Natech accidents in Czech Republic: Lessons learnt and related research Pavel DANIHELKA (Technical University of Ostrava, Czech Republic)
			II.2	The flood 2002 – Experiences of a hydrofluoric acid producing plant Christian WEISS (Fluorchemie Dohna GmbH, Germany)
			II.3	French regulation for integration of natural hazards in industrial safety assessment – Choice of reference scenarios to characterise these natural phenomena Cédric BOURILLET (Ministry of Ecology, France)
			II.4	Methodology for integration of flood hazard in industrial safety assessment Agnès VALLEE (INERIS, France)
			II.5	The German technical rule for process safety: Prevention and preparedness related to precipitation and floods hazards Karl-Erich KOEPPKE (Dr. Köppke GmbH, Germany)
16:10	16:40			Discussion
16:40	17:10			Coffee Break
17:10	18:50			Earthquake Risks
			II.6	Natech accidents resulting from the 11 March 2011 earthquake and tsunami and follow-up Yuji WADA (AIST, Japan)
			II.7	Lessons from the Sendai industrial complex and Chiba's Cosmo oil refinery fires following the great eastern Japan earthquake and tsunami Ana Maria CRUZ NARANJO (Consultant, France & Japan)
			II.8	Cancelled
			II.9	The Natech events during the 17 August 1999 Kocaeli earthquake: Aftermath and lessons learned Serkan GIRGIN (EC Joint Research Center)
			II.10	New French seismic regulation for hazardous industrial facilities Adrien WILLOT (INERIS, France)
18:50	19:30			Discussion
19:30				Meeting of Consultant and Rapporteurs
20:00	**22:00**			Dinner – Reception at the Conference Hotel

Thursday, 24 May 2012				
08:30	**11:00**			SESSION II: Natech Risk Management – Best Practices of Industry & Authorities (continued)
08:30	08:50			Other Hazards
			II.11	Seveso Directive: Plants threatened by bush fires: Analysis of several reported cases and guidelines proposal Jean-Paul MONET (French Fire & Emergency Management Service)
08:50	09:00			Discussion
09.00	10:20			Methodology
			II.12	Proposal of methodology for combined natural and technological risks identification and assessment Pavel DOBEŠ (Technical University of Ostrava, Czech Republic)
			II.13	A bow-tie for Natech: Approach for quantitative assessment of risk associated to Natech scenarios Valerio COZZANI (University of Bologna, Italy)
			II.14	The challenge of making 'typical and atypical' major hazard scenarios in the chemical industry Richard GOWLAND (European Process Safety Center)
			II.15	Lessons learnt from natural disasters Charles COWLEY (Center for Chemical Process Safety, USA)
10:20	11:00			Discussion
11:00	11:30			Coffee Break
11:30	13:30			SESSION III: Consideration of Climate Change in Natech RM Chair: Manfred STOCK (PIK, Germany) Rapporteurs: Roland FENDLER/ John BREWINGTON (UBA, Germany / Environment Agency, UK)
11:30	12:50			
			III.1	New results on extreme events Wilfried KUECHLER (Saxon Agency for Env., Agriculture & Geology)
			III.2	Adaptation measures of the oil and gas industry Ana Maria CRUZ NARANJO (Consultant, France & Japan)
			III.3	Engagement of BASF in adaptation to climate change Monika BAER (BASF AG, Germany)
			III.4	National Grid's climate change adaptation journey Gary THORNTON (National Grid, UK)
12:50	13:30			Discussion
13:30	14:30	.		Lunch
14:30	15:30			SESSION IV: Application of the Polluter-Pays-Principle (PPP) to Natechs Chair: Peter KEARNS (OECD) Rapporteur: Marie-Chantal HUET (OECD)
14:30	15:10			
			IV.1	Polluter-Pays-Principle, Tort law, natural catastrophes and liability insurance Christian LAHNSTEIN (Munich Re, Germany)
			IV.2	Role of insurance when the polluter pays Judith GOLOVA (MARSH Insurers, UK)
15:10	15:30			Discussion
15:30	16:00			Coffee Break

16:00	19:00			SESSION V: International Co-operation on Natech Risk Management Chair: Mark HAILWOOD (LUBW, Germany) Rapporteur: René NIJENHUIS (UNEP/OCHA)
16:00	17:00			International Projects
			V.1	Needs assessment study on chemical accident prevention and preparedness in region 8 of the Philippines Jean C. BORROMEO (Philippine Dep. of Environment & Natural Resources)
			V.2	APELL process in Sri Lanka: Preparation of integrated emergency preparedness plans for two selected industrial zones Jayavilal FERNANDO (Central Environmental Authority, Sri Lanka)
			V.3	Projects of the UNECE Convention of the transboundary effects of industrial accidents to support prevention, preparedness and responses to Natechs Chris DIJKENS (UNECE Chair of the Conference of the Parties)
17:00	17:30			Discussion
17:30	18:10			International Assistance
			V.4	International chemical environment Jos VERLINDEN (CEFIC, Belgium)
			V.5	The hazard identification tool (HIT) : A tool to identify and address secondary environmental risks Dennis BRUHN (OCHA Environmental emergencies section)
18:10	18:30			Discussion
19:00				Meeting of Consultant and Rapporteurs
19:00	**20:30**			Reception by the Government of Saxony (at the Sächsische Staatskanzlei Archivstr.1)
Friday, 25 May 2012				
09:00	13:30			Conclusions and Recommendations Chair: Roland FENDLER (UBA, Germany) Rapporteurs of Sessions I to V
09:00	09:30			Presentation of C&R from Session I – Discussion
09:30	10:30			Presentation of C&R from Session II – Discussion Discussion
10:30	11:00			Coffee Break
11:00	11:30			Presentation of C&R from Session III – Discussion
11:30	12:15			Presentation of C&R from Session IV – Discussion
12:15	13:00			Presentation of C&R from Session V – Discussion
13:00	13:30			Farewell – End of workshop

ANNEX 2

SUMMARY OF PRESENTATIONS

Session I – Natural hazards: Risk mapping and warning systems

The session stated the importance of developing and disseminating natural hazard maps for an effective Natech risk management. It pointed out the responsibility of the competent authorities for hazard and risk mapping. Some examples of good practices related to natural hazard warning systems (local systems for extreme weather, floods, tsunami and earthquakes) which were described in the Discussion Document that was made available for participants.

Risk mapping

Martin Socher (Saxon State Ministry of the Environment & Agriculture, Germany) reported that right after the flood in August 2002, a new interactive online flood forecast system has been established in Saxony. Furthermore, flood hazard and flood risk maps have been elaborated, which consider residential areas as well as industry plants for all main Saxon river catchments. The maps show the effects of flood events with a return period of 20, 100 and more years (extreme events). A new pilot project informs house owners and plant operators via a special internet platform about the risks of flood, heavy rainfall, storm and lightning capable to affect their buildings and plants.

Hans Kienholz (KiNaRis, Switzerland) addressed the integrated risk management approach in Switzerland. The basis for risk management is the presentation of hazard and risk maps for flood, debris flows, avalanches, landslides and rockfall in the Internet. The system provides maps with all locations of possible emissions of chemicals. The maps can be combined with different natural hazards maps (such as earthquake and/or flood) so operators can realize whether their plant can be exposed to two or more different hazards. The time of return can by varied between 50 and 500 years. The map scale can be adjusted by the user to receive exact information with high resolution about potential natural hazards in the location of interest. Furthermore, maps of historical events are provided. In this interactive system special information is prepared for each historical event.

Alexander Jovanovic (European Virtual Institute for Integrated Risk Management) described an innovative concept of use of GIS and conceptual mapping in identification and monitoring of Natech risks and its practical application in large EU and national projects (the EU project iNTeg and the German Helmholtz project "Energy-Trans"). The concept is based on (1) GIS maps, (2) conceptual maps, (3) stakeholders' interaction maps and (4) Influence diagrams & Bayesian networks. These four main types of mapping are used for the early identification, early warning and monitoring of Natech related risks. In the GIS maps the layers of data are usually those about the objects in the layers, such as capacity or age of plants (for example refineries, LNG terminals) types/categories of dangerous materials and similar. The data about natural hazards (such as earthquakes) can be used for superposition and calculation of 'critical risk distances/relations'.

Serkan Girgin (EC Joint Research Center) presented a new probabilistic Natech risk mapping methodology for earthquakes including its implementation in a software tool called "Rapid-N". The primary aim of Rapid-N is rapid Natech risk assessment and mapping by using fragility curves for damage estimation. Simple models for consequence assessment are used requiring a minimum of data on affected facilities. In order to facilitate the analysis, a property estimation framework was developed that can be used to calculate hazard parameters and site, process equipment, and substance properties. The framework has an expert system for selecting the most applicable estimators, based on data availability, validity conditions, and geographic location. Importing of available hazard maps is also supported. Rapid-N can be used for rapid damage estimation following actual earthquakes, as well as for land-use and emergency-planning purposes by using scenario earthquakes.

Warning systems

Ulrich Meissen (Fraunhofer Institute Open Communication Systems, Germany) presented the new local early warning system "SAFE" for hydrometeological events. The approach of SAFE is to use new sensor, system, and telemetric technologies in order to enhance the local quality of weather hazard prognoses and to perform targeted information dissemination for affected persons and systems. The central approach for enabling these new technologies and ensuring sustainability is the strong integration of private stakeholders in the project and in the long-term operation model of the system. The project successfully unites the interests of local authorities, insurances and larger industries, in particular the chemical industry. The new casting system (warning time less than six hours) is characterized by a high resolution in combination with a high reliability of the information, which makes the system useful for the industry.

Session II – Natech risk management – Good practices of industry and public authorities

It was recognised that some methods for risk analysis for industrial facilities and installations could be adapted for use in Natech risk analysis. But the necessity of further research and improvement was pointed out during the session. Some countries presented examples of regulations and guidance related to Natech risks. These regulations can be based on a similar methodological approach while the presentation requirements are adjusted to the local situations.

Pavel Danihelka (Technical University of Ostrava, Czech Republic). In 2002, a flood disaster has shown that flood protection for industrial plants for events with a return period of 100 years is insufficient. Not only floods but also extreme temperature or lightning triggered Natechs in the Czech Republic. Lessons learned from accidents were evaluated by the Czech Ministry of Environment, followed by recommendations and crisis planning comprising some Natech potential events, especially in the context of potential transboundary accidents triggered by flooding. Between 2007 and 2011, the MoE research project: "Complex interaction between industry and environment with regard to major accidents and emergency preparedness" was conducted with five cooperating research institutions and an important part addressed Natech accidents, and Natech risks mapping and evaluation.

Christian Weiss (Fluorchemie Dohna GmbH, Germany) reported on the flood that took place in August 2002. During this event the Müglitz creek flooded the area of the Fluorchemie in Dohna (Saxonia), where Hydrofluoric acid is produced. Due to the location of the plant – nearby mountains – the flash flood occurred very quickly. High flow velocity and floating debris caused huge damages to establishments, rails and electrical installations. Lessons learned from this event were that the whole risk management has been checked and improved. This includes preparation of the plant site before the flooding, training of the staff, and an early warning system. The elevation of relevant plant parts is a simple method to reduce flood risks. Weiss suggested that natural hazard worst case scenarios should be considered.

Cédric Bourillet (MEDDTL, France). The French regulation requires the consideration of natural hazards in the industrial safety assessment, as well as other internal or external initiating events, as long as they can induce the occurrence of major accidents. The integration of these natural hazards is based on reference scenarios. Natural events whose intensity is higher than the reference phenomenon may be excluded from the safety documents. For the natural reference events, it is necessary to demonstrate the strict compliance with the corresponding regulation in the safety documents. This is particularly true for earthquake, lightning, flooding, snow and wind, for which national specific regulations or good practices for hazardous industrial facilities exist. In case of compliance with these regulations the process of risk reduction at source is considered sufficient (deterministic approach).

Agnès Vallée (Ineris, France) stated that the mitigation efforts of flood-triggered Natech risks have taken two main directions in France; land-use planning in flood-prone areas and vulnerability reduction in flood-prone facilities. A methodology for the integration of flood hazard caused by dam rupture and unusual rainfalls in risk-reduction process for industrial plants is proposed by Ineris. This methodology follows a sequence in four steps: (1) Determination of the location of the plant inside or outside the flood-prone areas; if inside information about flood hazards must be collected. (2) Identification and systematic risk analysis of the endangered areas, facilities and equipments that could cause major technological accidents. (3) Analysis of the safety barriers. (4) Final analysis to assess if all barriers can be implemented at the same time, taking into account the available personnel and time between information on flood threat and the flood itself.

Karl-Erich Köppke (Prof. Dr. Köppke GmbH, Germany) presented the new German technical rule 310 for process safety: "Prevention and Preparedness related to precipitation and flood hazard". The technical rule is based on the following main elements: (i) hazard source analysis for identification of the relevant hazard sources, which could affect the site alone or in combination; (ii) analysis of hazards and threats, in order to realize the effects of a natural hazard on safety-relevant parts of establishments or installations; (iii) drafting of a protection concept; and (iv) review of 'major accidents despite precautions', which leads in particular to the specification of measures to mitigate the effects of major accidents. For the hazard source analysis a climate change factor of 1.2 on the natural hazard intensity shall be applied to describe future events if there is no separate evaluation of the climate change aspect. For the elaboration of a protection concept the climate change factor has also to be applied to all installations which will be operated beyond 2050.

Earthquake risks

Yuji Wada (AIST, Japan) introduced a survey related to the events occurring during 11th March 2011 and the impact of the earthquake and tsunami on chemical plants in Japan. According to the warning levels (tsunami and earthquake) most of the facilities were shut down in time. Nevertheless one third of the chemical plants were severely damaged. Nearly 50% of the plants which were damaged by the earthquake were also affected by the tsunami. These events show that one natural hazard can trigger a second one, which is more hazardous than the first one.

Ana Maria Cruz Naranjo (Université de Bordeaux, France) presented the results of two Natech accidents investigations in Japan: (1) the JX Refinery and neighbouring facilities at the Sendai industrial complex (Miyagi Prefecture), and (2) the Cosmo Oil Refinery and industrial complex in Chiba (Chiba Prefecture). Both sites suffered multiple fires, hazardous materials releases and oils spills affecting several facilities. For each case study the various event trees and failure mechanisms leading to the multiple fires and hazardous materials releases were presented. Furthermore, the risk management and emergency response to the accidents were analysed. Lessons learned from the disaster in 2011 are that not only the normal operation of the plant has to be considered but also operation periods for maintenance. Furthermore transport routes and pipelines should be objects of Natech risk management. This Natech Risk Management should consider that first responders can be hampered to arrive at the relevant locations during or after a natural event.

Serkan Girgin (EC JRC, Italy). The analysis of the 17th August 1999, Kocaeli earthquake – which was a devastating disaster hitting one of the most industrialized regions of Turkey – showed that even the largest and seemingly well-prepared facilities can be vulnerable to Natechs if risks are not considered adequately. The first part of the presentation was a detailed description of the events to emphasize what went wrong. One result is that a building without containing any hazardous chemical can destroy a safety relevant plant (tumbling of a stack). Furthermore, floating roofs, which may not be subject to the earthquake-resistant design of the buildings, can trigger a major accident. In a second part he reported about the recovery, restoration and remediation work completed during the past decade. Moreover, weaknesses in response to and management of the events were discussed and recommendations were derived for better Natech risk management. In this context Girgin suggested to consider realistic scenarios for the design of a plant and an emergency plan based on worst case scenarios.

Adrien Willot (Ineris, France) introduced the new French seismic regulation for hazardous industrial facilities, which divides France into five areas for seismic activity (area 1: very low seismic activity; area 5: high activity). In France industrial facilities are classified based on the types of the handled/ stored chemicals or on their activities ("classified installations"). The classified installations are subdivided in 'normal risk' or 'special risk' installations. For special risk installations the operator must verify that the plant is in compliance with the new regulations for elastic response spectra (vertical and horizontal) in acceleration, representing the seismic movement of one point in the surface. For existing installations, a study to assess the technical measures necessary to protect from earthquakes must be carried out before December 31st 2015, and the implementation of these measures must not be beyond 1st January 2021.

Other risks

Jean-Paul Monet (Fire and Emergency Management Service, France). In the Mediterranean areas, the main concern about natural risks is related to forest- and bushfires. Accidents have threatened high risks plants for many years (*e.g.* nuclear power plants, high risk industrial plants or trading estates). During the last five years, more than six cases have been reported, introducing a new approach to the art of fire fighting and in the preparedness of the 45 Seveso-sites of this French territorial part. The integration of these new scenarios in the safety report is underway. The fire service has listed some guidelines in order to provide the industrial plants involved with new procedures. During the winter during 2011-2012, the fire service used the prescribed fire tool to decrease the biomass quantity in the area nearby petrochemical plants. During the discussion about this report it was pointed out that due to climate change drought may become more frequent in several countries. This may increase the risks of wildfires for the hazardous facilities.

Methodology

Pavel Dobeš (Technical University of Ostrava, Czech Republic) presented a methodology for natural and technological risks identification and assessment. The proposed methodology is divided into 10 separated steps. It is mainly oriented on vulnerabilities in the potentially affected areas and integrates several approaches and experiences developed mainly in the European region in the past decade.

Valerio Cozzani (University of Bologna, Italy) presented a Natech risk assessment methodology based on a bow-tie approach. On the left wing the natural hazards have to be considered and on the right wing the consequences like fire, explosion and release of hazardous substances. While for the right wing existing models for conventional consequence scenarios can be used, special Natech models are required for the left wing. Key challenges are the description of the possible impacts, the identification of vulnerable parts of facilities, and the impact/consequence relations. Additional examples were given to illustrate the practicability of the method. The analyzed examples showed that the risks caused by Natechs could be higher than risks during normal operation. Further research is necessary to improve this method and to add further natural hazards.

Richard Gowland (EPSC) reported that the analysis of Natechs shows that natural hazards were often not sufficiently considered in the safety documents. One reason may be that they are not addressed in the usually applied risk analysis techniques. They are often characterized as ‘unknown unknowns’. Gowland asked in his presentation, whether natural hazards are really “unknown unknows” or are predictable and should be considered in risk analysis. Therefore, Gowland suggested considering natural hazards in risk analysis, at least in worst case scenarios.

Charles Cowley (CCPS, USA) presented the CCPS-publication (Center for Chemical Process Safety in the US) "Lessons Learned from Natural Disasters". Herein the implementation of a Natural Disaster Plan for endangered plants is suggested. Examples of an on-site consequence analysis and off-site consequences are presented in the booklet. CCPS intends to revise his guidance on plant siting. For this revision recommendations to consider natural hazards could be integrated.

Session III – Consideration of climate change in Natech risk management

In this session it was recognised that Natech risk management should take the consequences of climate change into consideration. A corporate strategy for adaptation to climate change supports this approach.

Udo Mellentin (Saxon Agency for Environment, Agriculture & Geology, Germany) gave an overview of the analysis of climate change. Climate change has altered the intensity, frequency, and geographic extent of some types of extreme events and is expected to continue to increase in the future. New temperature records are examples of such extreme events. Heat waves in particular show a high probability of worsening over most land areas in the upcoming years due to rising global air temperatures. Future trends in cyclone activity and tornadoes were more difficult to assess due to limitations in monitoring records and climate forecasting models. Moreover, global warming is projected not only to increase sea levels but also to intensify the hydrological cycle and increase the magnitude and frequency of intense precipitation and river flood events in many parts of the world.

Ana Maria Cruz Naranjo (Université de Bordeaux, France) assessed the vulnerability of the oil and gas industry to climate change, and discussed available options for mitigation and adaption. Climate change and hydrometeorological events represent a real physical threat to this industrial sector, particularly infrastructure located in low-lying coastal areas and areas exposed to hydrometeorological events. The oil and gas industry will have to identify high risk areas, assess its vulnerability to climate change and take appropriate measures to prevent or mitigate any potential negative effects.

Monika Baer (BASF AG, Germany) reported about the strategy of the BASF group for monitoring of an adaptation to climate change. The focus is more on extreme whether events than on gradual climate change. The activities can be summarized in three steps: (1) Collecting of climate data for major BASF Sites (climate tables, climate trends, extreme weather events, floods of the past): (2) Evaluation of water availability for BASF sites located in water-stressed areas at present and in future: (3) Preparation for the impacts of climate change at BASF sites. This includes heat waves, fluctuating groundwater levels, storms, floods and heavy rain events. The adaption of the BASF sites takes place in regular revisions and includes emergency plan update, review of safety requirements regarding precautions against risks arising from floods or other extreme weather events, and adaptation of plant safety management systems for extreme weather events. The Natech Risk Management is embedded in the overall strategy for adaptation to climate change of the BASF.

Gary Thornton (National Grid, UK) explained that National Grid is an international electricity and gas company in the United Kingdom. The National Grid participates in a climate change adaptation process of the UK Energy Networks Association (Climate Change Journey). Key vulnerabilities in the energy sector are those associated with higher temperatures and an increased intensity of precipitation and therefore flooding. Other possible vulnerabilities may include changes in wind, increased frequency of lightning etc. The evaluation of Natech risks by facilities containing hazardous substances is a part of these activities.

Session IV – Application of the Polluter-Pays-Principle to Natech accidents

The Session shows that gaps in liability exist. The responsibility for consequences of Natechs is still an open debate.

Christian Lahnstein (Munich Re, Germany) explained that causes of catastrophes may be unforeseeable or unavoidable ("Act of God"), but not necessarily their harmful consequences due to triggered chemical accidents. In many countries there are general rules which impose strict liability, independent of negligence, mostly based on the specific danger of certain activities like handling hazardous substances. "Act of God" can be a decisive defence, but not necessarily. It can be argued that natural catastrophes just activate the specific danger of a particular activity, on which strict liability is based. A full insurance cover is possible for consequences of Natechs in case of strict liability. There is an open debate about sense and nonsense of liability gaps in many laws.

Judith Golova (Marsh Insurers, UK) suggested that regulators should encourage the uptake of special Environmental Impairment Liability insurance. An alternative to strict liability of operators is a taxed based compensation to victims or of environmental damage. The later can cause large cost of governments. Best practice in accident prevention, preparedness and response should be applied for events able to foresee or plan for and insurance should cover consequences of events not possible to foresee. Insurance can be enforced as an integral component of environmental permits and operational licenses. Few countries have to this day made environmental cover compulsory for those types of industry that handle or store hazardous chemicals.

Session V – International co-operation on Natech risk management

The Session pointed out the necessity of international cooperation and gave examples of good practices.

Jean C. Borromeo (Department of Environment & Natural Resources, Philippines) reported on a disaster risk management project in Eastern Visayas of the Philippines. The Philippines experience a lot of natural disasters which are able to cause Natechs. In the project details on the quantity, character and location of hazardous substances in industrial facilities in the area, as well as the necessary precautions with respect to chemical accident management, were identified and served as the basis for identifying capacity building needs of the Region in order to strengthen its chemical accident risk management capability.

Jayavilal Fernando (Central Environmental Authority, Sri Lanka). In the aftermath of the tsunami catastrophe in December 2004 the United Nations Environment Programme (UNEP) through the Ministry of Environment (MOE) came forward to offer assistance to the Government of Sri Lanka to implement a programme on 'Awareness and Preparedness for Emergencies at Local Level' (APELL) in Sri Lanka. Accordingly, it was decided to implement a project at two pilot industrial zones in order to reduce disaster vulnerability and enhance the ability of the national and local level institutions and the private sector to manage natural and man-made disasters.

Chris Dijkens and **Virginia Fuse** (UNECE) introduced projects under the UNECE Convention of the Transboundary Effects of Industrial Accidents to support countries – especially those with economies in transition – in preventing, preparing and responding to industrial accidents, including the effects of such accidents caused by natural disasters.

Jos Verlinden (Cefic, Belgium) presented the ICE (Intervention in Chemical transport Emergencies); it is the co-operative programme of the chemical industry. This includes three levels: Level 1: Remote product information and general advice by telephone/fax/email; Level 2: Advice from an expert at the scene of the incident; Level 3: Assistance with personnel/equipment at the scene of an incident. This assistance is given by the ICE members (suppliers of chemicals) transboundary, if required. ICE Emergency Response Intervention Cards are provided in 16 languages (http://www.ericards.net). The scope of ICE is limited to transport accidents at the moment. Some elements may be suitable for international assistance in case of Natechs as well.

Dennis Bruhn (OCHA Environmental emergencies section) stated that natural disasters often have secondary impacts, *e.g.* damage to infrastructure and industrial installations. The Hazard Identification Tool (HIT) was developed by the Joint UNEP/OCHA Environment Unit (Joint Environment Unit/JEU) as a support tool for the United Nations Disaster Assessment and Coordination (UNDAC) Team and other emergency first responders, including environmental experts, 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.

ANNEX 3

LIST OF PARTICIPANTS

Austria/Autriche	Mr. Armin HEIDLER V/1 - Plant-related environmental Protection Federal Ministry for Agriculture, Forestry, Environnment and Water Management V/1 - Plant-related environmental Protection Stubenbastei 5 1010 Vienna Austria Tel: +43 1 51522-2109 Fax: +43 1 51522-7122
Czech Republic/République tchèque	Mr. Pavel DANIHELKA Head of the Lab on Research and Risk MGT Faculty of Risk Enggineering Technical University of Ostrava Ostrava Lumírova 13 Ostrava-Výškovice Czech Republic Tel: +420 597 322 822 Fax: +420 597 322 983
	Mr. Pavel DOBES Researcher Faculty of Safety Engineering Technical University of Ostrava Lumírova 13 700 30 Ostrava Czech Republic Tel: + 420 597 322 883 Fax: + 420 597 322 983

Finland/Finlande

Mrs. Leena AHONEN
Senior Safety Engineer
Safety Technology Authority
Lönnrotinkatu 37
00180 Helsinki
Finland

Tel: +358 405 788 249
Fax: +358 759 1596

France

M. Cédric BOURILLET
Head
Accidental Risk Division
Ministry of Ecology, Sustainable Development, Transport and Housing/Ministère de l'Ecologie (MEDDTL) - DGPR/SRT/SDRA
Grande Arche de la Défense
92055 La Défense Cedex
France

Tel: +33 1 40 81 89 79
Fax: +33 1 42 19 13 93

Mrs. Maud CASIER
Chargée de mission
Direction Générale de la Prévention des risques
Ministry of Ecology, Sustainable Development, Transport and Housing (MEDDTL)
Bureau des risques technologiques et des industrie
Grande Arche Paroi Nord 92055 La Défense Cedex
France

Tel: +33 1 40 81 90 21

Ms. Ana Maria CRUZ NARANJO
Consultant
HSE, IUT
Université de Bordeaux I
11, rue Jean Mermoz
33800 Bordeaux
France

Tel: +33 556 743596

France

Ms. Carine EL HAJJ
PhD Student in Risk Management
Institut Fayol
Ecole Nationale Supérieure des Mines de Saint Etienne (ENSME)
158, cours fauriel
42023 Saint etienne
France

Tel: +33 477499758

M. Jean-Paul MONET
Lieutenant-colonel / Conseiller technique Nrbc zonal
French Fire and EM Services
Service départemental d'incendie et de secours des Bouches du Rhône - SDIS 13
Place Jean Jaurès
Immeuble Lou Gabian, Bât E
13130 Berre
France

Tel: + 33 4 42 34 00 12

Mr. Xavier STREBELLE
Adjoint au chef du bureau des risques technologiques des industries chimiques et pétrolières
Direction générale de la prévention des risques
Ministère de l'Ecologie, de l'Energie, du Développement durable et de la Mer
Grande Arche de la Défense
92055 La Défense Cedex
France

Tel: +33 1 40 81 89 78

Ms. Agnès VALLEE
Direction des Risques Accidentels
INERIS
Parc Technologique ALATA - BP2
60550 Verneuil-en-Halatte
France

Tel: +(33)3 44 55 62 44
Fax: +(33) 3 44 55 62 95

France

M. Adrien WILLOT
Ingénieur
Unité Résistance des structures Direction des Risques Accidentels
INERIS
88 boulevard Lahitolle
18020 Bourges

Tel: + 33 2 48 48 40 43
Fax: + 33 2 48 48 40 34

Germany/Allemagne

Mr. Roland FENDLER
Industrial Installation Safety
Federal Environmental Agency
WORLITZER PLATZ 1
06844 Dessau
Germany

Tel: +49-340-2103-3679
Fax: +49-340-2104-3679

Mr. Mark HAILWOOD
Scientific Employee, Chair of the OECD Working Group on Chemical Accidents
Technical Environmental Protection
LUBW Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg
Griesbachstr. 1
76185 Karlsruhe
Germany

Tel: +49-721-5600-3181
Fax: +49-721-5600-3200

Mr. Georg BÖHME-KORN
Saxon State Ministry of the Environment and Agriculture
Wilhelm-Buck-Str. 2
01097 Dresden
Germany

Germany

Dr. Dieter COHORS-FRESENBORG
Federal Environmental Agency (Umweltbundesamt)
Wörlitzerplatz 1
06844 Dessau-Rosslau
Germany

Tel: +49 340 2103 3233
Fax: +49 340 2104 3233

Dr. Ursula FISCHBACH
Commission on Process Safety (KAS)
Merowingerstr. 88
40225 Dusseldorf
Germany

Tel: +49 6151 629 3617
Fax: +49 61 403 0105

Mr. Peter GAMER
Head of Division
Plant-Related Emissions and Noise
Saxon State Agency for the Environment, Agriculture and Geology
Pillnitzer Platz 3
01326 Dresden-Pillnitz

Tel: +49 351 2612 5200

Dr. Wolfgang GIERKE
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
Robert-Schuman-Platz 3
D-53175 Bonn
Germany

Tel: 49 228 305 2460
Fax: 49 228 305 3225

Germany

Ms. Luise HUTKA
Research Associate
Professorship of Geoinformation Systems
Technische Universität Dresden
Helmholtzstr. 10
01062 Dresden
Germany

Tel: +49 351 463 33576

Mr. Leo IBERL
Air Quality Management and Industrial Plant Safety
Bavarian State Ministry of the Environment and Public Health
Rosenkavalierplatz 2
81925 Munich
Germany

Tel: +49 89 9214 2124
Fax: +49 89 9214 2451

Mr. Fritz JAECKEL
Secretary of Staate
Saxon State Ministry of the Environment and Agriculture
Wilhelm-Buck-Str. 2
01097 Dresden
Germany

Mr. Oliver KALUSCH
Federal Association of Environmental Action Groups (BBU)

Tel: +49 2302 95 640 95

Mr. Michael KLEIBER
TA
Safety of Installations
Federal Environmental Agency
WORLITZER PLATZ 1
06844 Dessau
Germany

Tel: +49 340 2103 3019

Germany

Dr. Karl-Erich KÖPPKE
Consultant
Ing. Bureau Dr. Koeppke
Elisabethstraße 31
D-32545 Bad Oeynhausen
Germany

Tel: +49 5731 26111

Mr. Stephan KURTH
Nuclear Technology and Facility Safety Division
OEko-Institut e.V.
Rheinstr. 95
64295 Darmstadt
Germany

Tel: +49 160 533 3354

Mr. Christian LAHNSTEIN
Legal Counsel
Claims Management and Consulting
Munich Re
80791 Munich
Germany

Tel: +49 89 3891 9611
Fax: +49 89 3891 79611

Ms. Orsola LUSSIGNOLI
Federal Office of Civil Protection and Disaster Assistance (BBK)
Provinzialstr. 93
53127 Bonn
Germany

Tel: +49 228 99 550 3701
Fax: +49 228 99 550 3520

Mr. Ulrich MANN
Student
Cartography/GIS
TU Dresden

Tel: +49 1627690661

Germany

Mr. Rainer MÜTTERLEIN
Saxon State Ministry of the Environment and Agriculture
Pillnitzer Platz 3
01326 Dresden
Germany

Tel: +49 351 2612 5206

Ms. Ruth OLDENBRUCH
Division IG 1 4, Federal Ministry for the Environment
Federal Ministry for Environment, Nature Conservation and Nuclear Safety
Robert-Schuman-Platz 3
53175 Bonn
Germany

Tel: + 49 - 228 - 99305 2461
Fax: + 49 - 228 - 99305 2402

Dr. Norbert SCHIESS
Head of Division
Installation-related Pollution Control, Accident Prevention
Saxon State Ministry of the Environment and Agriculture
Wilhelm-Buck-Str. 2
01097 Dresden
Germany

Tel: +49 351 564 6530
Fax: +49 351 564 6529

Mr. Samuel SCHIESS
Student
University of Dresden

Tel: +49 162 7869693

Germany

Mr. Wolfgang SCHLÖSINGER
Control of Major Accident Hazards Involving Dangerous Substances
State Agency for Nature, Environment and Consumer Protection, North Rhine-Westphalia
Leibnizstr. 10
45659 Recklinghausen
Germany

Tel: +49 201 7995 1937
Fax: +49 201 7995 1910

Ms. Simone SCHMIDT
Desk Officer
Saxon State Ministry of the Environment and Agriculture
Archivstr. 1
01076 Dresden
Germany

Tel: +49 351 564 6532
Fax: +49 351 564 6529

Professor Martin SOCHER
Professor
Sächsisches Staatsministerium für Umwelt und Landwirtschaft
Archivstr. 1
01097 Dresden
Germany

Tel: +49 351 564 2440

Mr. Manfred STOCK
Potsdam Institute for Climate Impact Research (PIK)
Telegraphenberg A 31
14473 Potsdam
Germany

Tel: +49 331 288 2500

Germany	Dr. Gernot THUMA Reactor Safety Analyses GRS Schwertnergasse 1 50667 Köln Germany Tel: +49 (0)221 2068 607 Fax: +49 (0)221 2068 10607
	Ms. Johanna WATOROWSKI Process Safety Federal Environment Agency Tel: +49 157 8678 1996
	Mr. Gerhard WINKELMANN Safety of Installations Federal Environmental Agency Woerlitzer Platz 1 06844 Dessau Germany Tel: +49 340 2103 3289
Italy/Italie	Dr. Valerio COZZANI Department of Chemical Engineering Alma Mater Studiorum - Università di Bologna DICMA - via Terracini 28 40131 Bologna Italy Tel: +390512090240 Fax: +390512090247
	Mr. Andrea SANTUCCI Directorate for the Environmental Protection Ministry of Environment and Land Protection Rome Via Cristoforo Colombo, 44 Rome Italy Tel: 0039 06 5722 5045

Japan/Japon

Dr. Yuji WADA
Group Leader
Research Institute of Science for Safety and Sustainability (RISS)
National Institute of Advanced Industrial Science and Technology (AIST)
AIST West Site,
16-1 Onogawa
305-8569 Tsukuba
Japan

Tel: +81 29 861 8837
Fax: +81 29 861 8763

Netherlands/Pays-Bas

Mr. Chris DIJKENS
Director, International Enforcement Cooperation
ILT/Hazardous Substances and Products
Ministry of Infrastructure and the Environment
Graadt van Roggenweg 500
3531 AH Utrecht
Netherlands

Tel: +31 70 339 1421

Mr. Peter J.M.G. FRIJNS
Safety and Risks Department
Ministry of Infrastructure and the Environment
Rijnstraat 8
P.O Box 20901
2500 EX The Hague
Netherlands

Tel: +31 (70) 339 4429
Fax: +31 (70) 339 1286

Ms. Anneke RAAP
Senior Policy Maker
Safety and Risks
Ministry of Infrastructure and Environment

Tel: +31 70 456 6302

Norway/Norvège

Ms. TORILL F. TANDBERG
Director of Department
Industry, Products and Hazardous Substances
Directorate for Civil Protection and Emergency Planning
Ramberg veien 9
P.O.Box 2014
N-3103 Tønsberg
Norway

Tel: +47 33412750

Ms. Vibeke HENDEN NILSSEN
Senior Engineer
Directorate for Civil Protection and Emergency Planning
PO Box 2014
NO-3103 Tønsberg
Norway

Switzerland/Suisse

Mr. Daniel BONOMI
Deputy Head of Section
Section Safety of Installations and Earthquake Mitigation
3003 Berne
Switzerland

Tel: +41 31 322 93 98
Fax: +41 31 324 78 66

Mr. Hans KIENHOLZ
KiNaRis
Caecilienstrasse 31
3007 Berne
Switzerland

Tel: +41 31 371 04 31

Turkey/Turquie

Ms. Betül KURADA
AFAD Assistant Specialist, Environmental Engineer
Department of Planning & Mitigation
Prime Ministry Disaster and Emergency Management Presidency
Basbakanlik Afet ve Acil durum Yönetimi Baskanligi
mustafa kemal mahallesi dumlupinar bulvari no:274
06800 Ankara
Turkey

Mr. Mehmet Fatih SEN
AFAD Assistant Specialist & Environmental Engineer
Department of Planning & Mitigation
Turkish Prime Ministry Disaster & Emergency Management Presidency
Mustafa Kemal Mah. Dumlupinar Bulvari No:274
Ankara
Turkey

Tel: +90 (312) 287 26 80
Fax: +90-312-2873851

United Kingdom/Royaume-Uni

Mr. John BREWINGTON
Environment Agency
Trentside Offices
Scarrington Road, West Bridgford, Nottingham
NG2 5FA
United Kingdom

Tel: + 44 (0) 115 8463627

Ms. Judith GOLOVA
Broker, Environmental Insurance
Environmental Practice
Marsh Ltd
Tower Place
EC3R 5 BU London
United Kingdom

Tel: +44 20 7357 3675

United Kingdom	Mr. Gary THORNTON Asset Strategy & Engineering Manager Electricity Network Investment National Grid 2 Herring Road CV9 2NZ Atherstone United Kingdom Tel: +44 7785 527 154
EU/UE	Professor Aleksandar JOVANOVIC CEO European Virtual Institute for Integrated Risk Management Haus der Wirtschaft, Willi-Bleicher-Straße 19 D- 70174 Stuttgart Germany Tel: +49 711 1839 781 Fax: +49 711 1839 685
	Dr. Elisabeth KRAUSMANN Joint Research Centre European Commission Via E. Fermi 2749 21027 Ispra (VA) Italy
	Dr. Serkan GIRGIN Joint Research Centre European Commission Via E. Fermi 2749 21027 Ispra (VA) Italy
Philippines	Ms. Jean BORROMEO Supervising Environmental Management Specialist Manila Bay Coordinating Office/Office of the Undersecretary for Field Operations Department of Enviroment and Natural Resources Tel: +63 292 81225

Romania/Roumanie

Ms. Maria Magdalena DUTA-GHERGUT
Senior Adviser
Risk Management (Seveso)
National Environmental Protection Agency

Tel: + 40 722 68 76 47

Ms. Marilena GHIU
Senior Advisor
Directorate for Pollution Control and Impact Assessment
Ministry of Environment and Forests
12 Libertatii Blvd. Sector 5
RO-040129 Bucharest
Romania

Tel: +40 740 52 86 41

Mr. Francisc SENZACONI
Head of Major Accidents Risk Activities Control Bureau (Seveso)
Disaster Prevention
General Inspectorate for Emergency Situations
Disaster Prevention Office
Bucharest
Romania

Tel: +40 744 33 57 75

Sri Lanka

Mr. Jayavilal FERNANDO
Deputy Director General & Project Director
Environmental Education & Awareness/National Solid Waste Disposal Facility Project
Central Environmental Authority
No. 104. Denzil Kobbekaduwa Mawatha
Battaramulla
Sri Lanka

Tel: +94 0094-11-2872297
Fax: +94-11-2872609

Business and Industry Advisory Committee (BIAC)/Comité consultatif économique et industriel (BIAC)	Professor Christian JOCHUM European Process Safety Centre (EPSC) Robert-Stolz-Str. 54 D-65812 BAD SODEN Germany Tel: 0049-6196-61656 Fax: 0049-6196-61657
	Dr. Matthias ANDRES CEO Ingenieurgesellschaft Krätzig & Partner Buscheyplatz 9-13 44801 Bochum Germany Tel: +49 234 709940
	Ms. Monika BAER BASF SE Ludwigshafen 67056 Germany Tel: +49621 6049296
	Mr. Charles COWLEY Staff Consultant Center for Chemical Process Safety American Institute of Chemical Engineers 3 Park Avenue 10016-5991 New York United States Tel: +44 7771 650308
	Dr. Helge-Juergen DARGEL BTS-PME-CSA Bayer Technology Services B610 51368 Leverkusen Germany Tel: +49 214 305 0619

BIAC

Dr. Caspar-Heinrich FINKELDEI
Evonik Industries AG
Rodenbacher Chaussee 4
63457 Hanau
Germany

Tel: +49 6181 59 6199
Fax: +49 6181 59 76199

Mr. Richard GOWLAND
Technical Director
European Process Safety Centre
165-189 Railway Terrace
CV21 3HQ Rugby
United Kingdom

Tel: +44 1485 572 384
Fax: +44 1485 572 384

Mr. Thilo HÖCHST

Verband der Chemischen Industrie e. V.

Chemical Industry Association
Mainzer Landstrasse 55
60329 Frankfurt am Main
Germany

Tel: +49 69 2556 1507
Fax: +49 69 2556 2507

Mr. Josef SCHORR
GUU/LZ - Umweltzentrale
BASF SE

Tel: +49 621 60 49080
Fax: +49 173 347 86 13

Mr. Björn THRUN
TÜV Rheinland Industrie Service GmbH (TÜV Rhineland Industry Service)
Alboinstr. 56
12103 Berlin
Germany

Tel: +49 30 7562 1682
Fax: +49 30 7562 1724

BIAC	Mr. Jos VERLINDEN Director, Transport and Logistics CEFIC Av. E. van Nieuwenhuyse 4 1160 Brussels Belgium Tel: +32 2 676 73 95 Fax: +32 2 676 74 32
	Mr. Christian WEISS Industrial Advisory Service Peguera S.L. Betriebsstätte Deutschland Robert Koch Str. 8 50181 Bedburg Germany Tel: +49 2272 97 89 180 Fax: +49 22729789181
UN Economic Commission for Europe (UNECE)/Commission économique pour l'Europe des Nations Unies (CEE-ONU)	Ms. Virginia FUSÉ Programme Officer Environment Division United Nations Economic Commission for Europe Palais des Nations 8-14 avenue de la Paix 1211 Geneva Switzerland Tel: +(00)41 22 917 4149 Fax: +(00)41 22 907 01 07
UN Environment Programme (UNEP)/Programme des Nations Unies pour l'environnement (PNUE)	Mr. Dennis BRUHN UN Environment Programme (UNEP) Kloverprisvej 89 2650 Hvidovre Denmark Tel: +45 2723 6478

UNEP	Rene NIJENHUIS Humanitarian Affairs Officer - Environmental Emergencies Section Emergency Services Branch UNEP/OCHA Office for the Coordination of Humanitarian Affair Palais de Nations - bureau D-119 CH 1211 Geneva Switzerland Tel: +41 22 917 1815 Fax: +41 22 917 0257
	Ms. Katsiaryna PAULEVETS Business and Industry Unit - Sustainable Consumption and Production Branch United Nations - Environment Programme (UNEP) Division of Technology, Industry and Economics 15 rue de Milan 75009 Paris France Tel: +33 1 44 37 42 91
OECD/OCDE	Mme Marie-Chantal HUET Administrator, Chemical Accidents ENV/EHS OECD 2 rue André-Pascal 75016 Paris France Tel: +(33-1) 45 24 79 03
	Mr. Peter KEARNS Principal Administrator ENV/EHS OECD 2 rue André-Pascal 75016 Paris France Tel: +(33-1) 45 24 16 77