OECD Workshop

Natech Risk Management

Natural Hazards Triggering Technological Accidents

23rd to 25th May 2012

at Dresden, Germany, International Congress Center

Refinery and Shipping Facilities at SENDAI, Japan (March 12th, 2011)

Workshop Proceedings

Draft by 20.04.12

- Draft Program
- Natech Risk Reduction in OECD Member Countries
- (Discussion Document)
- Abstracts
- List of participants

Dessau-Roßlau, 2012

Dresden, Germany

Umweltbundesamt (Federal Environment Agency)
Division III 2.3 Safety of Installations
Wörlitzer Platz 1
D-06844 Dessau-Roßlau

Time		Room	Doc	
				Tuesday, 22th May 2012
14:00	~ 16:00	**Bus Departure:** Main Entrance Congr. Center		**Excursion to the site of Flourchemie Dohna** (Natech Risk Management at a site threatened by flashfloods (presentation II.2)
16:00	20:00	Lounge		**Registration, distribution of badges and workshop documents** GFI Umwelt, Bonn, Germany
18:00	19:00	Group Room #		**Meeting of the chairs, speakers, rapporteurs, consultant** **Roland FENDLER** (Federal Environment Agency (UBA), Germany)
				Wednesday, 23th May 2012
08:00	09:00	Lounge		**Registration, distribution of badges and workshop documents** GFI Umwelt, Bonn, Germany
09:00	**10:00**	**Conf. Room**		**OPENING SESSION: Welcome & Introduction**
				Ruth OLDENBRUCH (Federal Ministry for the Environment, Germany)
				Minister Frank KUPFER (to be confirmed) (Minister for the Environment and Agriculture, Free State of Saxony)
				Marie-Chantal HUET (OECD)
09:15	09:30		**QS**	**Natech Risk Reduction in OECD Member Countries: Results of a Questionnaire Survey** Elisabeth KRAUSMANN (EC Joint Research Center)
09:30	10:00		**DD.**	**Presentation of the Discussion Document** Karl-Erich KÖPPKE (Consultant, Dr. Köppke GmbH, Germany)
10:00	**13:30**	**Conf. Room**		**SESSION I: Natural Hazards: Risk Mapping and Warning Systems** **Chair: C1 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			**I a Presentation 1.1 - 1.2: Natural Hazard Mapping**
			I.1	**P1.1 Hazard and Risk Maps as a Main Element of Flood Risk Management: Lessons Learnt after 2002 Flood in Saxony** **SP1.1** Martin SOCHER (Saxon State Ministry of the Environment and Agriculture)
			I.2	**P1.2 Principles of Risk Management for Natural Hazards: The Case of Switzerland** **SP1.2** Hans KIENHOLZ (KiNaRis, Switzerland)
10:40	11:00			**Discussion**
11:00	**11:30**	**Lounge**		**Coffee Break**
11:30	12:10			**I b Presentation 1.3 – 1.4: Natech Risk Mapping**
			I.3	**P1.3 Use of GIS and Conceptual Mapping in Identification and Monitoring of Natech Risks** **SP1.3** Aleksandar JOVANOVIC (European Virtual Institute for Integrated Risk Management)
			I.4	**P1.4 RAPID-N: A Tool for Mapping Natech Risk Due to Earthquakes** **SP1.4** Serkan GIRGIN (Turkey)
12:10	12:30			**Discussion**

Time		Room	Doc	
12:30	13:10			**I c Presentation 1.5 - 1.6: Warning Systems**
			I.5	**P1.5 SAFE. An Example of an Extreme Weather Hazard Warning System for Communities and Industries** **SP1.5** Ulrich MEISSEN (Fraunhofer Institute for Open Communication Systems, Germany)
			I.6	**P1.6 Istanbul Earthquake Rapid Response and Early Warning System** **SP1.6** Mustafa ERDIK (Bogazici University, Turkey)
13:10	13:30			**Discussion**
13:30	**14:30**	**Conf. Center Rest.**		**Lunch**
14:30	**19:00**	**Conf. Room**		**SESSION II: Natech risk management (including emergency planning) – Best practices of industry and authorities** **Chair: C2 Christian JOCHUM** (European Process Safety Center) **Rapporteur: Elisabeth KRAUSMANN / Agnes VALLEE / Roland FENDLER** (EC, Joint Research Center/ INERIS, France/ Federal Environment Agency, Germany)
14:30	16:10			**II a Presentation 2.1 - 2.5.: Flood Risks**
			II.1	**P2.1 NATECH accidents in Czech Republic: Lessons learned and Related Research** **SP2.1** Pavel DANIHELKA (Technical University of Ostrava, Czech Republic)
			II.2	**P2.2 The Flood 2002 – Experiences of a Hydrofluoric Acid Producing Plant** **SP2.2** Christian WEISS (Fluorchemie Dohna GmbH, Germany)
			II.3	**P2.3 French Regulation for Integration of Natural Hazards in Industrial Safety Assessment – Choice of Reference Scenarios to Characterize these Natural Phenomena** **SP2.3** Cédric BOURILLET (French Ministry of Ecology, Sustainable Development, Transports and Housing)
			II.4	**P2.4 Methodology for Integration of Flood Hazard in Industrial Safety Assessment** **SP2.4** Agnes VALLEE (Institute on Industrial Risk – INERIS, France)
			II.5	**P2.5 The German Technical Rule for Process Safety: Prevention and Preparedness due to Hazards by Precipitation and Floods.** **SP2.5** Karl-Erich KOEPPKE (Dr. Köppke GmbH, Germany)
16:10	16:40			**Discussion**
16:40	**17:10**	**Lounge**		**Coffee Break**

Time		Room	Doc	
17:10	18:50			**II b Presentation 2.6 – 2.10: Earthquake Risks**
			II.6	**P2.6 Natech Accidents due to the 11 March 2011 Earthquake and Tsunami and Follow up** **SP2.6** Yuji WADA (National Institute of Advanced Industrial Science and Technology (AIST), Japan)
			II.7	**P2.7 Lessons from the Sendai Industrial Complex and Chiba's Cosmo Oil Refinery Fires Following the Great Eastern Japan Earthquake and Tsunami.** **SP2.7** Ana Maria CRUZ NARANJO (Consultant)
			II.8	**P2.8 Natech accidents happened during 12 May 1998 Wenchuan earthquake and risk prevention measures in China** **SP2.8 QI Yanhong** **(Environmental Emergency & Accident Investigation Center (EEAIC), Peoples Republic of China)**
			II.9	**P2.9 The Natech Events During the 17 August 1999 Kocaeli Earthquake: Aftermath and Lessons Learned** **SP2.8** Serkan GIRGIN (Turkey)
			II.10	**P2.10 New French Seismic Regulation for Hazardous Industrial Facilities** **SP2.10** Adrien WILLOT (Institute on Industrial Risk – INERIS, France)
18:50	19:30			**Discussion**
19:30		Group Room #		**Meeting of Consultant and Rapporteurs**
20:00	**22:00**	**Hotel Rest.**		**Dinner - Reception at the Conference Hotel**

Time		Room	Doc	
Thursday, 24th May 2012				
08:30	11:00	Conf. Room		**SESSION II: Natech Risk Management (Including Emergency Planning) – Best Practices of Industry and Authorities** - continued -
08:30	08:50			**II c Presentation 2.10: other Hazards**
			II.10	**P2.11 Seveso Directive Plants Threatened by Bush Fires: Analysis on Several Reported Cases and Guidelines Proposal** **SP2.10.** Jean-Paul MONET (French Fire and Emergency Management Service)
08:50	09:00			**Discussion**
09.00	10:20			**II d Presentation 2.13 – 2.16: Methodology**
			II.11	**P2.12 Proposal of Methodology for Combined Natural and Technological Risks Identification and Assessment.** **SP2.11** Pavel DOBEŠ (Technical University of Ostrava, Czech Republic)
			II.12	**P2.13 A Bow-tie for Natech: Approaching the Quantitative Assessment of Risk Associated to Natech Scenarios.** **SP2.12** Valerio COZZANI (University of Bologna, Italy)
			II.13	**P2.14 The Challenge of Making 'Typical and Atypical' Major Hazard Szenarios in the Chemical Industry** **SP2.13** Richard GOWLAND (European Process Safety Center)
			II.14	**P2.15 Lessons Learnt from Natural Disasters** **SP2.14** Charles COWLEY (Center for Chemical Process Safety, USA)
10:20	11:00			**Discussion**
11:00	**11:30**			**Coffee Break**
11:30	**13:30**	**Conf. Room**		**SESSION III: Consideration of Climate Change in Natech Risk Management** **Chair: C3 Manfred STOCK** (Potsdam Institute for Climate Impact Research (PIK), Germany) **Rapporteur: Roland FENDLER / John BREWINGTON** (Federal Environment Agency, Germany / Environment Agency, UK)
11:30	12:50			**Presentation 3.1 – 3.4**
			III.1	**P3.1 New Results on Extreme Events** **SP3.1** Wilfried KUECHLER (Saxon Agency for Environment, Agriculture and Geology)
			III.2	**P3.2 Adaptation Measures of the Oil and Gas Industry** **SP3.2** Ana Maria CRUZ NARANJO (Consultant)
			III.3	**P3.3 Engagement of BASF in Adaptation to Climate Change** **SP3.3** Monika BAER (BASF AG)
			III.4	**P3.4 National Grid's Climate Change Adaptation Journey** **SP3.4** Gary THORNTON (National Grid, UK)
12:50	13:30			**Discussion**
13:30	**14:30**	**Conf. Rest.**		**Lunch**

Time		Room	Doc	
14:30	**15:30**	**Conf. Room**		**SESSION IV: Application of the Polluter-Pays-Principle (PPP) to Natechs** **Chair: C4 Peter KEARNS** (OECD) **Rapporteur: Marie-Chantal HUET** (OECD)
14:30	15:10			**Presentation 4.1 – 4.2**
			IV.1	**P4.1 Polluter-Pays-Principle, Tort Law, Natural Catastrophes and Liability Insurance** **SP4.1** Christian LAHNSTEIN (Munich Re, Germany)
			IV.2	**P4.2 Role of Insurance When the Polluter Pays** **SP4.2** Judith GOLOVA (MARSH Insurers, UK)
15:10	15:30			**Discussion**
15:30	**16:00**	**Lounge**		**Coffee Break**
16:00	**19:00**	**Conf. Room**		**SESSION V: International Co-operation on Natech Risk Management** **Chair: C5 Mark HAILWOOD** (State Institute for Environment, Monitoring and Nature Conservation Baden-Württemberg) **Rapporteur: René NIJENHUIS** (UNEP/OCHA Environmental Emergencies Section)
16:00	17:00			**V a Presentation 5.1 - 5.4 International Projects**
			V.1	**P5.1 Needs Assessment Study on Chemical Accidents Prevention and Preparedness in Region 8, Phillippines** **SP5.11** Jean C. BORROMEO (Philippine Department of Environment and Natural Resources)
			V.2	**P5.2 Apell Process in Sri Lanka: Preparation of Integrated Emergency Preparedness Plans for Two Selected Industrial Zones** **SP5.12** Jayavilal FERNANDO (Central Environmental Authority, Sri Lanka)
			V.3	**P 5.3 Projects of the UNECE Convention of the Transboundary Effects of Industrial Accidents to Support Prevention, Preparedness and Response to Natechs** **SP5.3** Chris DIJKENS (UNECE Chair of the Conference of the Parties)
17:00	17:30			**Discussion**
17:30	18:10			**V b Presentation 5.4 - 5.5 International Assistance**
			V.4	**P5.4 International Chemical Environment** **SP5.4** Jos VERLINDEN (cefic)
			V.5	**P5.5 The Hazard Identification Tool (HIT) – a Tool to Identify and Address Secondary Environmental Risks** **SP5.5** Dennis BRUHN (OCHA Environmental emergencies section)
18:10	18:30			**Discussion**
19:00		Group Room #		**Meeting of Consultant and Rapporteurs**
19:00	**20:30**			**Reception by the Government of Saxony** **(at the Sächsische Staatskanzlei Archivstr.1 see: 8)**

Time		Room	Doc	
Friday, 25th May 2012				
09:00	**13:30**	**Conf. Room**		**Conclusions and Recommendations** **Chair: Roland FENDLER** (Federal Environment Agency, Germany) **Rapporteurs**
09:00	09:30		**S1**	**Presentation of C&R from Session I** **Discussion**
09:30	10:30		**S2**	**Presentation of C&R from Session II** **Discussion**
10:30	**11:00**	**Lounge**		**Coffee Break**
11:00	11:30		**S3**	**Presentation of C&R from Session III** **Discussion**
11:30	12:15		**S4**	**Presentation of C&R from Session IV** **Discussion**
12:15	13:00		**S5**	**Presentation of C&R from Session V** **Discussion**
13:00	**13:30**		**F**	**Farewell**
13:30				**Transfer to Dresden Airport** (on request) GFI Umwelt, Bonn, Germany

A. Sächsische Staatskanzlei
Archivstr 1
01097 Dresden

Natech Risk Reduction in OECD Member Countries: Results of a Questionnaire Survey[1]

Natech Risk Reduction in OECD Member Countries: Results of a Questionnaire Survey

Elisabeth KRAUSMANN (EC, Joint Research Center)

The European Commission's Joint Research Centre (JRC) carried out a questionnaire survey to assess Natech risk management practices and awareness of Natechs, collect case histories and lessons learned, and identify needs and/or limitations in implementing Natech risk reduction strategies in European Union Member States and OECD Member Countries. The results of the survey are intended to lead to better designed and targeted Natech risk reduction strategies. The questionnaire was sent to the members of the OECD Working Group on Chemical Accidents (WGCA), with a request to complete the questionnaire and involve other stakeholders in their countries if deemed necessary. A total of 20 OECD Member Countries returned the completed questionnaire. These countries are (in alphabetical order): Australia, Austria, Czech Republic, France, Germany, Iceland, Israel, Italy, Luxemburg, Netherlands, New Zealand, Norway, Poland, Slovakia, South Korea, Sweden, Switzerland, Turkey, United Kingdom and The United States of America.

The analysis showed a clear tendency towards recognising natural hazards as an important external risk source for chemical facilities and 40% of the responding countries declared to have suffered one or more Natech accidents with the release of toxic substances, fires and/or explosions and sometimes fatalities and injuries between 1990 and 2009.

Many survey respondents indicated that the improvement of existing regulations, as well as their enforcement, and the preparation of specific technical codes and guidelines would be required to fully address Natech risk in their country. While a legal framework for Natech risk reduction exists via the responding countries' chemical-accident prevention programmes, the effectiveness of these programmes in mitigating Natech risk is largely inconclusive. The occurrence of Natech accidents indicates that there may be gaps in legislation, implementation and/or its monitoring that should be addressed to ensure effective Natech risk reduction. It is interesting to note that Natech risk is hardly addressed in natural-disaster management regulations. Technical codes and standards for the design, construction and operation of buildings and structures in industry consider certain natural hazards but their ultimate goal is the safety of human life. Therefore, the prevention of hazardous-substance releases may not be guaranteed and secondary risks due to these releases may not be taken into account. Additionally, some of these technical codes and standards may not be suitable for controlling risks due to hazardous substances. Specific guidelines for Natech risk reduction to support legislation are scarce.

Awareness of Natech risk seems to be increasing within the countries' competent authorities although there is uncertainty as to the current level of knowledge on the dynamics of Natech accidents and the extent of training on Natech risk reduction. The latter was mentioned as one of the priority needs to be addressed by the survey respondents. It was felt that there may be a lack of awareness in industry, and in 40% of the responding countries industry appears to insufficiently take Natech risk into account during the industrial risk assessment process. In addition, there is a reported lack of Natech-specific scenarios. Low levels of Natech preparedness could therefore result. This highlights the need for better risk communication and the development of methodologies and tools for including Natech risk into conventional industrial risk assessment. Moreover, the development of guidance on Natech risk assessment for indus-

[1] Basing on the second edition of the JRC Report.

try was indicated as the highest-priority need for effective risk reduction, closely followed by the development of guidance on Natech risk assessment at the community level.

While Natech risk reduction measures were reported to exist, they are often generic which is not surprising due to the absence of data and models on the dynamics of Natech accidents. In fact, currently no specific Natech accident databases exist in the responding countries and Natech events have to be retrieved from conventional chemical-accident databases. Moreover, chemical-accident prevention regulations, such as the European Seveso II Directive, do not provide guidance to the operator on how Natech risk reduction should be achieved, nor to the competent authority on how to evaluate that the risk level is as low as required by regulations. This is a shortcoming that needs to be addressed. Similarly, it proved difficult to identify best practices dedicated to Natech risk reduction, with most reported examples targeted towards floods. This finding suggests that the availability of Natech-specific best practices may be limited at present and efforts should be directed towards filling this gap. Another priority need expressed by the survey respondents is the development of specific Natech risk maps which are to date barely available. These are required for the identification of Natech-prone areas to inform land-use-planning and emergency-management decisions. In contrast, many countries have developed natural hazard or risk maps for selected natural hazards in certain regions.

The results of this Natech questionnaire survey show that natural events have been recognised as a relevant source of risk to a chemical facility with the potential to trigger a major accident. However, the survey highlighted a number of research and policy challenges and gaps that hamper effective Natech risk reduction. The following areas for future work have been identified (in arbitrary order):

- Improvement of awareness raising and risk communication at all levels of government (national, regional, local) and in industry;
- Implementation and enforcement of specific regulations for Natech risk reduction;
- Preparation of guidelines for risk assessment in industry and specific technical codes that address Natech risk;
- Preparation of dedicated Natech emergency management plans which consider the possible lack of utilities;
- Development of Natech risk maps for effective land-use planning and emergency management;
- Development of guidance on Natech risk assessment at the community level;
- Land-use planning that explicitly addresses Natech risk;
- Training of competent authorities on Natech risk reduction both in the chemical-accident prevention and the natural-disaster management communities.
- Development of methods and tools for Natech risk assessment;
- Identification of best practices for Natech risk reduction and sharing of existing practices with other countries;
- Research into the impact of climate change on future Natech risk;

In addition to the above points it is recommended that lessons learned from the analysis of past Natech accidents should be formulated and disseminated widely. These lessons should address failure modes and hazardous-substance release paths as a function of natural-hazard severity, as well as identify risk-reduction measures and possible best practices. Moreover, indicators for measuring the effectiveness and adequacy of Natech risk-reduction measures should be developed.

It should be noted that over half of the responding countries have launched research activities and programmes to address the problem of Natech accidents. It is hoped that the findings of this report could help focus these research efforts in a productive way and foster multi-lateral collaboration in appropriate areas, such as data collection and analysis, the identification of best practices and the development of performance measures. Many of the above proposals could be addressed within the Natech Project Steering Group of the OECD WGCA if desired. Moreover, it is proposed that the relevant chapters in the OECD Guiding Principles on chemical accident prevention, preparedness and response be adapted to more explicitly consider Natech risk.

The JRC report on the results of the Natech questionnaire survey was reviewed and accepted by the Steering Group of the OECD WGCA Natech project, of which the JRC is a member, and it´s first edition welcomed by the 19th Meeting of the OECD Working Group on Chemical Accidents in October 2009.

Discussion Document

Erich KÖPPKE (Dr. Köppke GmbH, Germany)

(to be delivered)

Abstracts

Session I Natural Hazards: Risk Mapping and Warning Systems

I a Presentation 1.1- 1.2: Natural Hazard Mapping

P1.1 Hazard and Risk Maps as a Main Element of Flood Risk Management: Lessons Learnt after 2002 Flood in Saxony

SP1.1 Martin SOCHER (Saxon State Ministry of the Environment and Agriculture)

In August 2002 Germany and particularly the Free State Saxony were hit by three consecutive severe floods affecting practically two thirds of the State territory. The first flash flood originated from the Eastern Ore Mountains and caused extreme damages along five tributaries of the Elbe River including main parts of the historical city centre of Dresden. This flood was followed by a major river flood of the whole catchment area of the Mulde River with a return period between 250 and 500 years. Finally, the Elbe River coming from its headwaters in the Bohemian Mountains in the Czech Republic covered large parts of its original flood plain on both sides of the border and caused damages and losses in a hitherto unknown dimension. By the end of August 2002 it turned out that alone in Saxony 21 fatalities occurred, 25,300 houses were damaged, 200 of which were totally destroyed. In addition 7 hospitals, 236 schools, 110 kindergartens, 44 nursing homes and 18 homes of the handicapped were affected. Furthermore, the Saxon industrial base along the rivers was also seriously affected by severe damages, losses in production and shortages of supplies. The transport infrastructure was disastrously damaged as well including 750 km of roads, 540 km railway network and 180 bridges. In total the damage summed to about 6,196 Mio € not including indirect losses of the private economic sector. The water system could not withstand the mighty forces of the three floods, leading to around 18,000 individual damages at reservoirs, dykes, weirs, river soles and other hydraulic structures. During the flood the disaster management organisation got a main impact and input from the German Bundeswehr, US Troops stationed in Germany, governmental and non-governmental organisations from all over Europe. Right after the flood the Saxon Government decided to reorganise the flood protection system and related disaster management in Saxony with the following main elements.

- Reorganisation of the flood forecast system with due consideration of the single voice principle
- Establishment of Flood Protection Concepts for all main Saxon river catchments
- Establishment of Flood Hazard and Risk Maps for all areas under flood risk
- Programme of Measures for all related areas under risk

It turned out that all those elements are being addressed in the European Flood Risk Management Directive 2007/60/EC. During the severe Floods in 2006 and 2010 all those elements proofed to be important and necessary in order to cope with the actually existing flood risk. Flood Hazard and Risk Maps (HARM) have been widely distributed physically and electronically via the web to all competent authorities and to the public as well in order to use those maps during all stages of flood risk management such as prevention, protection and defence.

P1.2 Principles of Risk Management for Natural Hazards: The Case of Switzerland

SP1.2 Dr. Hans KIENHOLZ (KiNaRis, Switzerland)

Natural hazards have ever been an elementary issue in the everyday life in Switzerland. For centuries, the federal government, the cantons and the municipalities have made considerable efforts to mitigate their impact. But still, damages increased at an alarming rate.

Admittedly, absolute safety cannot be achieved, but great steps forward were made in the past few years on the road from conventional hazard protection to an integrated risk management. The latter approach is based on a balanced equilibrium of preparedness, response and recovery measures. A residual risk, which has to be defined considering social, economical and ecological criteria of well-being, must thereby be accepted. This ultimately leads to a sustainable risk management.

I b Presentation 1.3 – 1.4: Natech Risks Mapping

P1.3 Use of GIS and Conceptual Mapping in Identification and Monitoring of Natech Risks

SP1.3 Aleksandar JOVANOVIC (European Virtual Institute for Integrated Risk Management (EU-VRi)

The contribution explains an innovative concept of use of GIS (geographic systems maps) and conceptual mapping in identification and monitoring of NaTech risks and its practical application in large EU and national projects[2] respectively; respective sizes 19.3 and approx. 13 M €). The concept is based on

1. GIS maps,
2. conceptual maps (semantic analysis based),
3. stakeholders' interaction maps and
4. Influence diagrams & Bayesian networks.

These 4 main types of mapping are used for the activities related to early identification, early warning and monitoring of NaTech related risks. In all these types of maps the objects to be maps can be of a different type:

a) data about physical objects,

b) data about stakeholders and their behaviour, and

c) information (e.g. textual or graphical) about the objects and/or stakeholders.

The items in the maps can be hazards (tsunami, storms, earthquakes…), vulnerabilities (cities, infrastructures) or a combination of both (a nuclear power plant first as a vulnerability and than as a hazard). The data can be either "raw", i.e. as measured or pertinent to the very properties of the objects (e.g. quantities of dangerous materials, magnitude of earthquakes), or they can be derived data, e.g. indicators of the state of the object or its operational characteristics or calculated data (e.g. results of analyses performed such as percentage of equipment in the high risk zone or, e.g., radii of damage zones).

In the GIS the layers of data are usually those about the objects in the layers, such as capacity or age of power plants and refineries, types/categories of dangerous materials and similar. In conceptual maps, the emphasis is on the logical (contextual) vicinity of pieces of information. Natural gas fracking will in such a map be "nearer" to LNG storage plant than to, e.g., nanotechnology plant. The position and the vicinity of data in such a case are determined either on provided chunk of information only, or on the provided information combined with the ontological information (e.g. from system like GEMET[3]). For the stakeholders' maps, the most important contents are the information about the stakeholders themselves, but apart from the static information (e.g., number of stakeholders, their profiles, interests, etc.) also the dynamic information should be included (e.g. rules of their behaviour, possibly placed within the behaviour models of a given stakeholder node). In current applications in the above mentioned projects, the intelligent agent based modeling seems to be giving promising results, especially for these topics where the input of reliable data is straightforward – e.g. when the data about the stakeholders' "feelings" are easily available in large quantities (social networks, Tweet), which is often the case with data broadly discussed. The influence diagrams and the Bayesian networks are used for representing the probabilistic relationships between random variables in the NaTech risks space, e.g. between causes and consequences of risks. The data to be stored in the risk mapping systems may be observable quantities, latent variables, unknown parameters or hypotheses.

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[2] the EU project iNTeg-Risk (www.integrisk.eu-vri.eu) and the German Helmholtz project ENERGY-TRANS, (http://www.helmholtz.de/en/joint_initiative_for_innovation_and_research/initiating_and_networking/helmholtz_alliances/energy_trans/

[3] http://www.eionet.europa.eu/gemet

The most innovative part of the solution proposed is the one related to "risk distances": a parameter indicating how critical is a distance between two nodes one of which is in the vulnerability data layer (e.g. a refinery) and the other one in the hazard data layer (e.g. earthquake epicentre). The risk distance, as calculated in the system, is then proportional to the magnitude of the quake and the size of the refinery, and inversely dependent on the physical distance between the object and the quake. Factors possibly contributing can be related to the physical stage of the plant (e.g. age), contextual factors and similar. The critical couples of data (selected out of usually thousands of possible couples) can be finally represented at the map, indicating the critical pairs, and that is how it is done the systems being developed based on the above concepts in iNTeg-Risk and ENERGY-TRANS project.

P1.4 RAPID-N: A Tool for Mapping Natech Risk Due to Earthquakes

SP1.4 Serkan GIRGIN (Turkey)

Elisabeth Krausmann (EC Joint Research Center)

Natural-hazard triggered major accidents (Natechs) at industrial facilities are recognized as an emerging risk with possibly serious consequences. However, methodologies and tools to assess Natech risks are still limited in many aspects. Recent EU and OECD-wide surveys have shown that hardly any Natech risk maps exist in the Member States. Existing maps are found to be simple overlays of natural and technological hazards. A follow-up study has been performed to develop a probabilistic Natech risk mapping methodology for earthquakes and to implement it as 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 and simple models for consequence assessment with minimum data input. 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 readily available hazard maps is also supported. A basic set of fragility curves from the literature is provided for the damage assessment. If needed, custom damage states and fragility curves can be defined for different process equipment types. Conditional and probabilistic relationships can be specified between damage states and probable Natech event scenarios. The consequences of the Natech events are assessed using the Risk Management Program (RMP) methodology of the U.S. EPA and the results are presented as summary reports and interactive risk maps. 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.

I c Presentation 1.5 – 1.6: Warning Systems

P1.5 SAFE. An Example of an Extreme Weather Hazard Warning System for Communities and Industries

SP1.5 Ulrich MEISSEN (Fraunhofer Institute for Open Communication Systems, Germany)

In the past decade, we witnessed strong efforts in establishing effective Early Warning Systems (EWS) not only for natural hazards but also increasingly for anthropogenic, technical, or biological risks. Experiences from early warning projects indicate the importance of integrating private stakeholders, especially when it comes to cost-effective and sustainable long-term operation of such systems. Moreover, given the investment requirements in this area, such as for effective alerting technologies for the public, the integration of private resources becomes inevitable.

One important challenge in the successful implementation or improvement of an early warning system is evaluating and monitoring its efficiency. Yet there is no common proven evaluation approach and one of the major open research issues is the elaboration of cost-benefit models in this area. With the integration of private stakeholders, a quantitative model is becoming of major importance. In addition, the involved authorities need to have decision support tools to effectively invest into better disaster prevention and mitigation.

In this context we present SAFE, an a applied research pilot system aiming at local early warning systems of high quality, supported by technological disaster prevention measures that can make a significant contribution to protection from extreme weather hazards effects. 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 presentation includes a description of the development steps, field tests and the findings of the SAFE project. Based on user surveys, the interests and possible response activities of the different stakeholders have been investigated and transferred to the technological and operational requirements of a new generation EWS that sets high standards in terms of information quality, dissemination effectiveness for industry standards. This technological basis enables the realization of a variety of operational models for different stakeholders sharing the same infrastructure and thus being highly cost-effective. We consider SAFE as a blueprint for the successful technological cooperation of public and private stakeholders for better disaster prevention in the context of natural and industrial risks.

P1.6 Istanbul Earthquake Rapid Response and Early Warning System

SP1.6 Mustafa ERDIK (Bogazici University, Turkey)

Potential impact of large earthquakes on urban societies can be reduced by timely and correct action after a disastrous earthquake. Modern technology permits measurements of strong ground shaking in near real-time for urban areas exposed to earthquake risk. As part of the preparations for the future earthquake in Istanbul a Rapid Response and Early Warning system in the metropolitan area is in operation.

The Istanbul Earthquake Rapid Response System equipped with 100 instruments and two data processing centres aims at the near real time estimation of earthquake damages using most recently developed methodologies and up-to-date structural and demographic inventories of Istanbul city. After the transmission of ground motion parameters by the field stations, shake and building damage distribution maps, using spectral displacement based fragility relationships, are automatically generated and transmitted to emergency operation centres within 3 minutes using radio modem and GSM communication. The system has so far exposed to several small magnitude (ML=3-4) earthquakes and performed satisfactorily. The methodology developed for near real time estimation of losses after a major earthquake consists of the following general steps:

1. rapid estimation of the ground motion distribution using the strong ground motion data gathered from the instruments;
2. improvement of the ground motion estimations as earthquake parameters become available and
3. estimation of building damage and casualties based on estimated ground motions and intensities.

For the Early Warning system ten strong motion stations were installed as close as possible to the fault zone to transmit on-line data via digital radio modem and satellite telemetry. A simple and robust Early Warning algorithm, based on the votes of exceedance of specific filtered acceleration and cumulative absolute velocity (CAV) levels are implemented. The users of the early warning signal are power and gas companies, nuclear research facilities, critical chemical factories, subway system and several high-rise buildings.

SESSION II: Natech Risk Management (Including Emergency Planning) – Best Practices of Industry and Authorities

II a Presentation 2.1 – 2.5: Flood Risks

P2.1 NATECH accidents in Czech Republic: Lessons learned and Related Research

SP2.1 Pavel DANIHELKA (Technical University of Ostrava, Czech Republik)

Several NATECH type accidents happened in Czech Republic, triggered by flooding, temperature extremes or lightening. Some of them, typically in the extend of major accident, will be described and analysed from the NATECH perspective: chlorine release in Spolana Neratovice during flooding in year 2002, liquid waste tank explosion in Borsodchem Ostrava, cyanides release to Elbe river during winter 2006 or fuel tank explosion caused by cold temperature in 2011. Some other near-miss accidents or smaller accidents will be discussed as well.

Experience from accidents was evaluated by Czech Ministry of Environment, followed by recommendations and crisis planning comprising some NATECH potential events, especially in the context of potential trans-boundary accidents triggered by flooding. Between years 2007 and 2011, research project of MoE "Complex interaction between industry and environment with regard to major accidents and emergency preparedness" was realised with five cooperating research institutions and its important part was devoted to NATECH accident understanding, NATECH risks mapping and evaluation.

P2.2 The Flood 2002 – Experiences of a Hydrofluoric Acid Producing Plant

SP2.2 Christian WEISS (Fluorchemie Dohna GmbH, Germany)

The flood of the small river Müglitz and its consequences for a chemical production site will be shown in lots of pictures, made directly after the flood.

Content of this presentation as per February 2012:

1. Fluorchemie Dohna as Hydrofluoric Acid Producer (as a short introduction)
2. Hydrofluoric Acid – a very toxic and corrosive substance (as a short introduction)
3. Precautionary provisions of Fluorchemie Dohna for external influences on a safe production
    a) Safety for people inside and around the site
    b) Safety for production units on site
    c) Safety for railcars on site and off site
    d) Safety for infrastructure
4. Experiences during the flood of the river Müglitz – Answers of the questions:
    a) Did all precautions fulfill the needs?
    b) What did happen and how was it solved?
    c) Could a flood like this be expected?
5. Consequences and resulting reconstructions for the future

- New precautions against a new flood

P2.3 French Regulation for Integration of Natural Hazards in Industrial Safety Assessment – Choice of Reference Scenarios to Characterize these Natural Phenomena

SP2.3 Cédric BOURILLET,

Xavier STREBELLE (French Ministry of Ecology, Sustainable Development, Transports and Housing)

French regulation requires the consideration of natural hazards in the industrial safety assessment (in safety report), as well as other internal (technical failure, human error) or external (domino effects between nearby installations…) initiating events, as long as it induces 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 report (Order of May 10, 2000).

For the natural reference events, it is necessary to demonstrate the strict compliance for their corresponding regulation in the safety report (Circular of May 10, 2010). This is particularly true for earthquake, lightning, flooding, snow and wind, for which national specific regulation or good practices for hazardous industrial facilities exist. In these cases, if the rules are observed in the plant, the process of risk reduction at source is considered sufficient (deterministic approach). The probability of occurrence of the natural event is not evaluated and is not integrated in the calculation of probability of occurrence of associated major accidents (criterion used with severity to assess acceptability and make land-use planning decisions). The natural event should be treated by emergency plans.

For other natural hazards not listed above, such as avalanche, volcanic eruption…, there are no national specific regulations or best practices to their consideration. In these cases, the integration of these natural phenomena in the safety report is left to the discretion of the operator.

This approach brings up the question of the choice of natural phenomena to take as a reference. Should we consider realistic reference events (which happen often) or extreme events (based on what has already seen worse in the past, and increased to take into account events of even higher intensity, the climate change…)? What happens if a major accident occurs in an adequately dimensioned installation (regarding the natural phenomena taken in reference), because of intensity of natural aggression higher than imposed? What is the responsibility of authorities? of industry? The point of view of France on these questions will be exposed.

P2.4 Methodology for Integration of Flood Hazard in Industrial Safety Assessment

SP2.4 Agnes VALLEE (Institute on Industrial Risk – INERIS, France)

International databases such as OFDA and CRED show that floods accounted for more than half of disasters registered for the 1990-2001 period. With consequences of climate change largely unpredictable at local level, future statistics are not likely to show any improvement. As human activities historically developed in river areas and floodplains, industrial facilities are structurally exposed to flooding. Past events witnessed industrial vulnerability to flooding, including direct impact on structure; loss of safety measures; loss of utilities; business interruption etc.

In response to such natural-technological interaction, mitigation efforts have taken two main directions: land-use planning in flood-prone areas; vulnerability reduction in flood-prone facilities. This communication focuses on the former issue and presents good practice accumulated in France for the mitigation of flood impacts on industrial facilities.

To address this issue, INERIS proposes to present a methodology for the integration of flood hazard in risk-reduction process for industrial plants is proposed by INERIS. Both floods originated from a dam rupture and unusual rainfalls will be considered.

This methodology follows a sequence in 4 steps.

- The first step aims at determining whether the studied plant is located in a floodable area or not. If it is the case, data are needed to better understand the flooding, such as type of flooding, water height, flow velocity, speed of water level rising, flooding duration, return period of flood…
- Based on information gathered in step 1, the topography of the industrial plant, the location of buildings and facilities within plant perimeter, areas which could be affected by flooding are identified. In the potentially flooded areas, facilities and equipments that could cause major technological accidents are identified. A systematic risk analysis is then performed for each of these equipments. The accidental sequences leading to dangerous phenomena (fire, explosion, toxic cloud dispersion, pollution…) are detailed, and existing safety barriers are highlighted.
- The safety barriers are analyzed more in details in terms or performance (efficiency, maintainability, testability…). Each barrier shall be assessed also in terms of kinetics, depending on implementation time, availability of human resources, technical devices… Depending of the available time before the arrival of water and resources in case of flooding, some safety barriers are also selected for risk assessment and emergency plan.
- A final analysis should assess if all barriers can be implemented at the same time, taking into account the available personal and the available time between the information of flood threat and the flood itself.

A suggestion of possible safety barriers against flood will be made by INERIS.

Finally, the communication will discuss the experience gained by INERIS after implementation of this method to a SEVESO low-tier industrial site in France.

P2.5 The German Technical Rule for Process Safety: Prevention and Preparedness due to Hazards by Precipitation and Floods.

SP2.5 Karl-Erich KOEPPKE (Dr. Köppke GmbH, Germany)

In 2002 the east and south of Germany suffered due to a severe flood in summer. This flood caused loss of live and severe damage but also threatened several establishments according to the Seveso-Directive. One consequence of a research project for the Umweltbundesamt was, that the Technical Rules for installations and equipment did insufficient consider risks by natural hazards. Therefore the Umweltbundesamt issued a project to develop a draft for a Technical Rule on hazards due to precipitation and floods. This draft was further elaborated by the German Commission on Process Safety, tested by application on an establishment, passed the public hearing and the hearing of the Länder and is now officially published in the Federal Bulletin.

The scope, the methodological approach and the requirements of this Technical Rule shall be presented. Especially the proposed link between identification and analysis of natural hazards on one hand and methodological process safety analysis and risk management on the other hand shall be explained. Finally the presentation shall explain how this Technical Rule considers the possible increase of hazards by precipitation and floods due to expected climate change.

II b Presentation 2.6 – 2.9: Earthquake Risks

P2.6 Natech Accidents due to the 11 March 2011 Earthquake and Tsunami and Follow up

SP2.5 Yuji WADA (National Institute of Advanced Industrial Science and Technology (AIST), Japan)

The Great East Japan Earthquake had hit eastern Japan at 14:46, on March 11th, 2011. The Maximum magnitude was reported 9.0, at 130 km from east coast. The locations of earthquakes were about 200 km from east to west and about 500 km from north to south.

After the first great earthquake, the series of big aftershocks have followed and even only on a day, the number of aftershocks greater than magnitude 5 was 74, on March 11th. The next day, the number was reported as 99, and even now aftershocks have kept hitting Japanese land.

Even the earthquake itself was big enough to shake Japan, it was caused by another disaster, a Tsunami. The earthquake center was on the coast of Tohoku area, the north part of Japan, however, the Tsunami was observed everywhere in Japan.

The maximum height of the Tsunami was reported as 10-15 m, and the run up heights which the Tsunami went up along the slope were around 40 m at many points. Especially, Tsunami had struck severely the huge area of eastern Japan, and 561 km^2 of the area were inundated on the day.

And currently, the total number of fatality because of the earthquake and Tsunami are 15,845. Even after one year has passed, still 3,375 have remained missing.

After this great earthquake, some surveys have been done at the chemical plants to figure out the damage of the earthquake, Industrial Safety Division of NISA, METI, has done one of the surveys.

Another survey has been done at a chemical plant in Tohoku area to study the effect of earthquake vibration, liquefaction phenomena, etc., on the damage of the plant by the Japan Society of Safety Science.

The results of these surveys will be presented.

P2.7 Lessons from the Sendai Industrial Complex and Chiba's Cosmo Oil Refinery Fires Following the Great Eastern Japan Earthquake and Tsunami.

SP2.7 Ana Maria CRUZ NARANJO (Consultant)

KRAUSMANN, E.; IKEDA, N.; KAJITANI, Y. and TATANO, H.

This presentation concerns two case studies from an on-going study of impacts of the Great Eastern Japan earthquake and tsunami of 11 March 2011 on industry in Miyagi, Ibaraki and Chiba Prefectures in Japan. The study involved a series of field trips to the affected areas, and interviews and visits with government officials. The purpose of the study is to assess the performance of industrial risk management practices and emergency response to the Natech accidents that occurred.

The earthquake of magnitude 9.0 occurred off the Pacific coast of Tohoku, Japan, on March 11, 2011, at 14:46 Japan Standard Time (5:46:23 UTC). The rupture area, which was approximately 450 km ✥ 200 km, generated a tsunami 130 km off the coast of Miyagi Prefecture, northeast Japan. The tsunami inundated over 400 km✥ of land. As of 26 October 2011 the number of deaths was 15,829, the number of injured was 5,943, and the number of missing was 3,725 (Japan National Police Agency). The earthquake and tsunami caused complete or partial collapse of more than 300,000 houses. The earthquake and tsunami had a significant impact on industry, and in particular on petrochemical and chemical industry in the affected areas, resulting in hazardous-materials releases, fires and explosions with impacts on neighbouring communities, and leading to business interruption. The natural disasters led to economic impacts and supply-chain disruption due to the damage of production facilities or shortage of raw materials. The direct losses amount to more than 200 billion US dollars (not considering the Fukushima nuclear power plant accident). Although the earthquake produced strong ground motion, most damage was caused by the tsunami and not the earthquake. This highlights the effectiveness of Japan's earthquake damage reduction measures in saving lives and property.

This paper presents the results of the Natech accident investigations at two sites: the JX Refinery and neighbouring facilities at the Sendai industrial complex (Miyagi Prefecture), and the Cosmo Oil Refinery and industrial complex in Chiba (Chiba Prefecture). Both sites suffered which suffered multiple fires, hazardous materials releases and oils spills affecting several facilities and required several days to contain. For each case study the paper presents the various event trees and failure mechanisms leading to the multiple fires and hazardous materials releases, and analyses the risk management and emergency response to the accidents. Finally, the paper presents some preliminary lessons learned and recommendations on good (and bad) practices of industry and public authorities.

P2.8 Natech accidents happened during 12 May 1998 Wenchuan earthquake and risk prevention measures in China

SP2.8 QI Yanhong (Environmental Emergency & Accident Investigation Center (EEAIC), Peoples Republic of China)

The Environmental Emergency & Accident Investigation Center (EEAIC) is in charge of emergency response to major environmental pollution accidents and ecological damages as well as investigation of major and key environmental pollution accidents. The EEAIC guides and coordinates local governments to properly handle any major environmental pollution accidents. THE EEAIC is strengthening the management of emergency planning, preparedness, response and risk assessment.

The EEAIC has been developing cooperation with Canada Ministry of Environment on environmental emergencies from 2010.

Abstract of presentation:

1. Introduce the accidents happened during 12 May 1998 Wenchuan earthquake and activities in emergency responding.
2. Introduce current activities on Natech risk prevention, which include chemical risks investigation, hazard identification, risk assessments, risk prevention plans, and the risk management policies for operators and authorities.
3. Introduce existing problems in prevention Natech accidents
4. Recommendation and conclusion

P2.9 The Natech Events During the 17 August 1999 Kocaeli Earthquake: Aftermath and Lessons Learned

SP2.9 Serkan GIRGIN (Turkey)

Natural-hazard triggered technological accidents (Natechs) at industrial facilities have been recognized as an emerging risk. Adequate preparedness, proper emergency planning, and effective response are crucial for the prevention of Natechs and mitigation of the consequences. Under the conditions of a natural disaster, the limited resources, the possible unavailability of mitigation measures, and the lack of adequate communication complicate the management of Natechs. The analysis of past Natechs is crucial for learning lessons and for preventing or preparing for future Natechs.

The 17 August 1999, Kocaeli earthquake, which was a devastating disaster hitting one of the most industrialized regions of Turkey, offers opportunities in this respect. Among many Natechs that occurred due to the earthquake, the massive fire at the TUPRAS Izmit refinery and the acrylonitrile spill at the AKSA acrylic fiber production plant were especially important and highlight problems in the consideration of Natechs in emergency planning, response to industrial emergencies during natural hazards, and information to the public during and following the incidents. The fire at the refinery lasted for 5 days and could only be extinguished by international support. The spill of 6500 t of acrylonitrile (AN), a toxic substance, damaged domestic animals, affected agricultural activities, endangered public health, and resulted in environmental pollution that required 5 years of continuous treatment for reclamation. Both events required the evacuation of the settlements in the vicinity of the facilities and hampered search and rescue operations. There were also considerable economical losses.

Despite their adverse consequences, these Natech events and their aftermath provide valuable information and lessons for Natech risk management and shed light on what should and should not be done in case of such emergencies. The analysis of these events shows that even the largest and seemingly well-prepared facilities can be vulnerable to Natechs if risks are not considered adequately. In the presentation, first a detailed description of the events will be given to emphasize what went wrong, and then the recovery, restoration and remediation work completed during the past decade will be reported. Moreover, weaknesses in response to and management of the events will be discussed and recommendations will be made for better Natech risk management. The presented lessons learned from the case studies can be useful, not only for Turkey but also for other Natech-prone countries.

P2.10 New French Seismic Regulation for Hazardous Industrial Facilities

SP2.10 Adrien WILLOT,

Agnes VALLEE (Institute on Industrial Risk – INERIS, France)

A new regulation (Decrees 210-1254 and 2010-1255, dated October 22nd 2010) recently introduced a new zoning for seismic activity, dividing France into 5 areas, from areas 1 (very low seismic activity) to 5 (high activity).

This regulatory change comes from the authorities whose policy is to continuously improve the safety of citizens against seismic risk. Indeed, the previous zoning, valid since 1991, was based on studies performed in 1986. The development of scientific knowledge has led to a re-evaluation of seismic hazard and a re-definition of the zoning based on a probabilistic approach (taking into account the return periods).

In this context, the presentation of INERIS will focus on how this new zoning has to be considered in hazardous industrial facilities.

The industrial facilities in France are classified according to the properties of the handled/stored chemical products or according to their activities. We name these installations "classified sites".

With regards to the regulation which establishes the rules for protection against earthquake, the classified sites may be subject to regulation applicable to "normal risk" or "special risk" installations.

According to the Ministerial Order of 24 January 2011, "special risk" classified sites are pieces of equipment in low and upper-tier SEVESO establishments that may lead, in case of an earthquake, to one or more dangerous phenomena with lethal effects out of the site boundaries, unless there are no permanent human presence in this identified lethal effects area.

The elastic response spectra (vertical and horizontal) in acceleration, representing the seismic movement of one point in the surface on the right of the establishment are then elaborated, using information given in the Ministerial Order.

If the installation is new, compliance to regulation must be demonstrated when the operator submits a request for a permit to operate. Protective measures against the earthquake must then be implemented at the start of operations.

For existing establishments, 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 exceed 1st January 2021.

All other pieces of equipment in establishments that do not belong to the "special risk" category are considered as "normal risk" category. In this case, classified sites must apply the Order of 22 October 2010 like all buildings on French territory. There are rules for new buildings, or existing buildings in specific conditions, in seismic area 2, 3, 4 and 5. The application of Eurocode 8 is required, while leaving the possibility of using standard rules in the case of simple structures. The protection level is adjusted according to the structure involved.

The presentation will also bring lessons learned from the INERIS / Ministry scientific mission in Japan at the end of November 2011 (impacts of the earthquake and tsunami on industrial facilities), in particular the recommendations on the protection of establishments from earthquakes.

II c Presentation 2.11: Other Hazards

P2.11 Seveso Directive Plants Threatened by Bush Fires: Analysis on Several Reported Cases and Guidelines Proposal

SP2.11 Jean-Paul MONET (French Fire and Emergency Management Service)

F. VAUCOULEUR, R. AUBRUN (Bouches-du-Rhône Departmental Fire and Emergency Brigade)

In Mediterranean areas, main concern of natural risk is forest and bushfire. Since many years these accidents threaten high risks plants (e.g. radioactive power plants, high risk industrial plants or trading estates).

In 1989, an experimental nuclear site was slightly damaged by a forest fire.

In the last 5 years, more than 6 cases have been reported, introducing a "new deal", in the art of fire fighting and in the preparedness of the 45 Seveso classified plants of this French departmental territorial division.iuh

At first, the integration of these new scenarios in the safety report is on the road.

Secondly, the fire service has listed some guidance, in order to give new procedures to the industrial plants involved.

At last, during the 2011-2012 winter, the fire service use the prescribed fire tool to decrease the biomass quantity, in the nearby area around some petrochemical plants.

II d Presentation 2.12 – 2.15: Methodology

P2.12 Proposal of Methodology for Combined Natural and Technological Risks Identification and Assessment.

SP2.12 Pavel DOBEŠ (Technical University of Ostrava, Czech Republic)

One from important problems in the major accident prevention and preparedness are the combined natural and technological risks, often in the form of technological accidents triggered by natural phenomena. The goal of presented work was to propose the methodology applicable to assessment of such events.

Flow of energy, material and information are the principle of mutual interactions among different types of risks occurring at major accidents. According to complexity of real phenomena during these unwanted situations, many combined natural and technological risks could be identified. Large effort and energy were spent on solving of the problem of combined risk assessment, including the series of case studies on different types of various risks combinations around the world. Production of lessons learned also must not be neglected.

Combined risks represent different level of threat for human, property and often also for various compartments of the environment. In the contrary to combined risks, for the occurrence prediction and effect estimation of single risks, many methodologies and models are available and presented work. Proposed methodology aims to establish basis for identification and assessment of certain combined risks, including so called „NATECH" risks. During development of methodology, combined risks were studied on historical events by means of several approaches.

Proposed methodology is divided into 10 separated steps, which are furthermore briefly mentioned: defining the purpose and scope of analysis + gathering multidisciplinary oriented team; identification and selection of risks in the area; analysis of simple risks; assessment of single risks in relation to vulnerable targets; identification of possible interactions between selected risks including links on vulnerable targets; description of possible scenarios of combined risks; the assessment of combined risks; decision step with question was selected all relevant risks and their combinations; management of inacceptable risks in relation with vulnerable targets; periodic update and revision of the study. Links to related information resources and recommendations of applicable methods for each step are included. Proposal of methodology is oriented mainly on vulnerabilities in the potentially evaluated areas. In the methodology were integrated several approaches and experiences developed mainly in European region in past decade.

Application of proposed methodology assumes the organization of multidisciplinary oriented team of experts, according to selected combination of natural and technological risks. In the frame of specific application, experts have the high degree of freedom in the choice of analytical approaches for single risk.

P2.13 A Bow-tie for Natech: Approaching the Quantitative Assessment of Risk Associated to Natech Scenarios.

SP2.13 Valerio COZZANI (University of Bologna, Italy)

The increasing frequency of some natural events having a particularly high severity raised a growing concern for the integrity of critical industrial infrastructures and for the consequences of technological accidents that may be triggered by severe natural events.

The specific features of technological accidents triggered by natural events were recognized only rather recently, and these scenarios are now indicated as NaTech accidents. The screening of past accident databases points out that NaTech accidents are quite common in industrial facilities. However, these scenarios are seldom considered in the safety assessment of industrial facilities and a specific evaluation of the potential consequences of NaTech accidents is generally not carried out. In the present contribution, the specific features of NaTech scenarios will be evidenced, also discussing the results of past accident analysis. A possible framework for the quantitative assessment of NaTech scenarios will be defined and recent advances in the tools available for the quantitative analysis of risk associated to NaTech events will be presented. A specific insight will be given on fragility models for industrial equipment. Possible integrations with current practices adopted for technological risk management of industrial sites will be discussed.

P2.14 The Challenge of Making 'Typical and Atypical' Major Hazard Szenarios in the Chemical Industry

SP2.14 Richard GOWLAND (European Process Safety Center)

Major Hazard scenarios in the Chemical and Oil and Gas Industries must be identified and assessed as part of the corporate and legal and requirements for operation. The record shows that the industries and Competent Authorities have not always been able to predict or agree on a complete portfolio of these risks. These might be characterised as 'unknown unknowns'. It can be argued that we need to find better ways of predicting these more effectively, communicating them in a transparent manner and finding ways to prevent or mitigate them. It is also apparent that some predictable events have been characterised as not realistic or where probability and frequency data were missing and therefore protection has not been seriously considered.

Natech hazards can be said to fall into this category, since they might appear to be random. Traditional hazard identification methods such as Hazard and Operability study have served us well, but we should be considering how we can add to or enhance these. The European Process Safety Centre has a group which studied 'Atypical Scenarios' and has set out good practice for how this might be achieved. An approach which sets out all potential worst cases including those caused by Natech events and goes on to define causes and possible avoidance or protection strategies is evolving.

This includes the application of Layer of Protection Analysis (LOPA) to a wider range of scenarios. The combination of a creative approach to finding and characterising Natech hazards with simple risk assessment such as LOPA has potential to allow better decision making. The paper shares this progress and suggests practical ways of achieving a safer world.

P2.15 Lessons Learnt from Natural Disasters

SP2.15 Charles COWLEY (Center for Chemical Process Safety, USA)

Lessons Learnt from Natural Disasters, CCPS 2006:

Natural disasters over the last few years have tested preparedness and response plans of the chemical and petrochemical industries on or near the Gulf coast. Although responses were generally well managed and as efficient as conditions allowed, there is always room for improvement. In these cases, experience is often the best teacher, but everyone should not have to experience the same thing to learn from it. AIChE's Center for Chemical Process Safety (CCPS) member companies believe that sharing experiences and learning from others are effective and efficient ways of improving performance and reducing risk.

With that goal in mind this pamphlet, funded by the generous support of the United Engineering Foundation, pulls together, analyzes, and presents in a "how to use" format the recent experiences and successes of various CCPS member companies, their "Lessons Learned," and advice on how to prepare for and recover from a natural disaster. Most of this information comes from workshops in 2006, with the April workshop and the June teleconference as the focal events. Members of the CCPS Technical Steering Committee who participated in the June teleconference, Scott Berger—CCPS Director, Karen Person—CCPS Project Engineer, Karen Tancredi—Dupont, and Adrian Sepeda—CCPS Staff Consultant, are recognized for the role they played in bringing this project to fruition. This pamphlet merely "suggests" and in no way sets a standard or expectation for performance or actions. In the end, it is the responsibility of each company and its employees to act on their beliefs and available information to secure their site, protect their employees, and protect the community.

This pamphlet takes a risk based approach in addressing the chronological phases of dealing with a natural disaster—preplanning, just before the disaster strikes, during the disaster, and after the disaster recovery. The appendices provide check lists and examples that should be customized to suit your specific situation and company culture.

The CCPS chemical and petrochemical company members are well grounded in using risk evaluations as a tool to run their businesses safely. This paper uses that same risk evaluative approach in preparing for and recovering from a natural disaster. Each phase of the preparation and recovery should be evaluated for risks considering both probabilities and consequences. By doing so, actions can be preplanned, prioritized, properly scheduled, and evaluated for effectiveness and impact. Risk assessments should be made for two broad categories:

- the risk that a natural disaster imposes on the safety and security of your facility, its contents, equipment, chemicals, market share, and personnel; and
- the risk that your facility (while being impacted by a natural disaster) imposes on the surrounding community, ecosystem, and personnel.

These risk evaluations facilitate understanding of appropriate actions to take, when to take them, and required communications.

SESSION III: Consideration of Climate Change in Natech Risk Management

P3.1 New Results on Extreme Events

SP3.1 Wilfried KUECHLER (Saxon Agency for Environment, Agriculture and Geology)

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. At present we see a regional variation in temperature changes; increases are higher over land and in the northern hemisphere. It is only through the careful study of the pattern of events over years or decades that we can begin now to attribute the changing pattern of our weather and the weather extremes to climate change. For the time being, until humanity brings its greenhouse gas emissions under control, we can expect each decade to be warmer than the preceding one.

Even in the presence of the existing warming trend, natural climate variability can lead to more or fewer cold outbreaks in a given season and region. Coupling of natural climate modes can change the climate state for years including prolonged warming and cooling. Unfortunately, it is common for the public opinion to take the most recent local seasonal temperature anomaly as indicative of long-term climate trends.

The frequency of extreme warm anomalies increases disproportionately as global temperature rises. Some examples will be shown and should demonstrate the new quality of some extreme events (new temperature records for month, season and year after the millennium) not at least because of "Warming-Background" in many parts of the world and the coupling of changing circulation patterns to temperature and precipitation extreme events in Europe. So, in summer 2003 and July 2006 Western Europe and July 2010 Eastern Europe (Russia), respectively, suffered unusual extreme heat waves and dry spells. Heat waves in particular show a high probability of worsening over most land areas in 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 to intensify the hydrological cycle and increase the magnitude and frequency of intense precipitation and river flood events in many parts of the world. First significant changes in this direction are already clearly to be seen and will be discussed.

P3.2 Adaptation Measures of the Oil and Gas Industry

SP3.2 Dr. Ana Maria CRUZ NARANAJO (Consultant)

Elisabeth KRAUSMANN (EC Joint Research Center)

In this presentation we assess the vulnerability of the oil and gas industry to climate change, and discuss available options for mitigation and adaption. Current and future analytical frameworks are presented and their limitations discussed. Furthermore, the paper discusses other factors that will play a major role in the ability and/or willingness of the oil and gas industry to mitigate and/or adapt to climate change. Overall, the paper concludes that climate change and extreme weather events represent a real physical threat to this industrial sector, particularly infrastructure located in low-lying coastal areas, and areas exposed to extreme weather 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.

P3.3 Engagement of BASF in Adaptation to Climate Change

SP3.3 Monika BAER (BASF AG)

P3.4 National Grid's Climate Change Adaptation Journey

SP3.4 Gary THORNTON (National Grid, UK)

National Grid supports the views of Climate Change science and believes that mankind contributes to a level of climatic change. National Grid also recognises that meeting the challenges of climate change is not only about reducing greenhouse gas emissions and developing a low-carbon economy but also ensuring that National Grid adapts to climate change such as; incremental hotter drier summers, warmer and wetter winters, coastal and river bed erosion and increasingly frequent extreme weather events such as floods.

National Grid is at a very advanced stage of embedding its Climate Change policy for both mitigation and adaptation within the organisation, with climate change risks firmly embedded into National Grid's Risk Management Procedure which is constantly reviewed and updated with appropriate actions and targets.

Analysis and experience has shown that energy infrastructure may be vulnerable to certain aspects of climate change; however the infrastructure has a significant degree of resilience to change, and therefore adaptation. In addition, technically it will be feasible to deal with adaptation issues over short, medium and long-term periods.

In order to ensure National Grid is prepared for the affects of climate change, it is engaged, in conjunction with other UK energy companies and the scientific community focussing on mitigation and adaptation to climate change.

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.

This presentation will outline National Grid's adaptation story from the start of our adaptation work in 2006 through to the present day and beyond briefly discussing our future research within this field.

SESSION IV: Application of the Polluter-Pays-Principle (PPP) to Natechs

P4.1 Polluter-Pays-Principle, Tort Law, Natural Catastrophes and Liability Insurance

SP4.1 Christian LAHNSTEIN (Munich Re, Germany)

Environmental law: Multiple instruments realize the polluter pays-principle in environmental (public and private) law and policy. One of them is tort law.

Tort law: There are misunderstandings about the relationship between natural catastrophes, tort law and insurance. Under negligence rules, concepts like "Act of God" are irrelevant. Causes of catastrophes may be unforeseeable or unavoidable, but not necessarily their harmful consequences. In addition, in many countries exist general rules and also in most countries a historical patchwork of specific national and international rules which impose strict liability, independent of negligence, mostly based on the specific danger of certain activities. Here, "Act of God" can be a decisive defence, but not necessarily. It can be argued that natural catastrophes just realize the specific danger of a specific activity, on which strict liability is based. And there is an open debate about sense and nonsense of liability caps in many of these specific laws.

Liability insurance: As most natural catastrophes are accidents, there is full liability insurance cover, independent of whether the catastrophe is considered as "environmental" or not necessarily. But frequently there is poor insurance penetration (see the 2,000 € liability insurance limit in a Hungarian accident). Finally, there are misunderstandings about the relationship between liability caps and liability insurance limits.

P4.2 Role of Insurance When the Polluter Pays

SP4.2 Judith GOLOVA (MARSH Insurers, UK)

BACKGROUND

The environmental impacts of a chemical accident initiated by a natural disaster are well understood. For example, an earthquake can cause an oil spill from a tank storage which in turn results in soil and groundwater contamination.

Once the Polluter Pays principle has been firmly established into national law, and a polluter has been identified after a natural hazard event, one would expect that the polluter would start paying out for claims for bodily injury and property damage, and would start cleaning up the soil and water resources once it is safe to do so.

The reality is often disappointing. This is not because the polluter is unwilling to take responsibility to correct for the damage that has been done. It is because natural hazards often result in such severe damage that the polluter finds himself lacking the financial resources to respond.

This is where insurance needs to step in. Industry often prioritises to buy insurance for those risks that are easily foreseeable. Purchasing motor insurance for example is never disputed because everybody is aware of the risks of driving. Where risks and liabilities become more unforeseeable and rare, such as pollution events, insurance is often regarded to be only for those who can afford it, or for whom public pressure encourages it.

ENVIRONMENTAL IMPAIRMENT LIABILITY INSURANCE

When asked about how prepared an industrial operator is to respond to pollution, the false assumption is often that they already have pollution cover in their existing insurances. However, Public Liability policies will not typically provide any meaningful cover for any cleanup that is required by the regulator or environment agency rather than a third party. Furthermore, Public Liability policies will not respond to cleanup on the industrial site itself. Lastly, Public Liability policies will not respond to biodiversity damage.

The Environmental Impairment Liability insurance market has developed significantly and is able to provide effective risk transfer solutions for operational and/or historic pollution and environmental damage risks. This can be structured to cover on-site and off-site legal liabilities arising from pollution/contamination on, at, under or emanating from an insured site. Policy wordings do not exclude natural hazards and there is usually no need to establish that the insured was at fault.

CONCLUSION

Regulators should encourage the uptake of specialist Environmental Impairment Liability insurance. This will allow industry to be more resilient to natural hazards, some of the effects of which cannot be foreseen or managed using engineering controls.

SESSION V: International Co-operation on Natech Risk Management

V a Presentation 5.1 – 5.3: International Projects

P5.1 Needs Assessment Study on Chemical Accidents Prevention and Preparedness in Region 8, Phillippines

SP5.1 Jean C. BORROMEO (Philippine Department of Environment and Natural Resources)

It has already been recognised that in developing countries, the effects of natural disasters often impact upon vulnerable communities which do not have sufficient resilience to prepare for, mitigate and recover from such events. The impact of a natural disaster on a facility handling hazardous substances in the vicinity of these communities can therefore have devastating effects on an already exposed population.

This "Needs Assessment Study" was conducted as part of the German International Cooperation's (GIZ) Disaster Risk Management Project in Eastern Visayas (Region 8) of the Philippines. 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.

The Study is based on desk top research and on-site visits to a selection of facilities handling hazardous chemicals in the Eastern Visayas Region which took place between 28th July and 5th August 2010. The chemical facilities considered were those with substantial quantities of hazardous chemicals and ranged from ice manufacturing plant through fuel terminals to large scale chemical processing of the fertilizer and the copper smelting and refining industries. Household chemicals, e.g. cleaning agents and small scale commercial activities, e.g. gasoline filling stations, hardware stores, engine cleaning activities, LPG dealerships, were excluded from the study. The study area covers the Eastern Visayas Region, however there is little industry of significant size handling hazardous chemicals outside of the Province of Leyte.

Notable among the findings of the study were that while the identity of the hazardous chemicals in use in the facilities visited is generally correctly given, the quantities of these chemicals at any given time are unknown. Moreover, the use of GHS classification and labeling is generally only applied if this is the system adopted by the chemical supplier and systematic hazard identification and risk assessment is carried out only in a very few cases. Further, while some general awareness of which natural hazards affect the Region of Eastern Visayas exists, there is little awareness of specific potential effects on individual facilities and installations unless this has been identified as a high operational risk. There is often a lack of awareness of the need for emergency planning and thus a lack of communication with emergency responders or the local community. Some facilities do have good hazardous chemical management practices in place and a strong CSR program with links to the community and fire departments but there is a large gap between the most developed practices and those of simpler facilities.

Based on these findings, a range of recommendations were made towards capacity building of the local and regional authorities in the field of process safety using existing industry networks to share best practice and to establish "codes of practice" for particular activities such as chlorine water treatment or ammonia refrigeration systems. In addition, it was recommended to use local knowledge to develop chemical hazard maps at the Barangay level so that response planning, land-use planning and natural disaster preparedness are able to have a more informed decision making process.

P5.2 Apell Process in Sri Lanka: Preparation of Integrated Emergency Preparedness Plans for Two Selected Industrial Zones

SP5.2 Jayavilal FERNANDO (Central Environmental Authority, Sri Lanka)

In the aftermath of 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 locations viz; the Koggala Export Processing Zone (KEPZ) and the Ekala Industrial Estate (EIE) which were likely to face natural and industrial hazards. The French Ministry of Ecology and Sustainable Development, France provided the necessary funding for the implementation. The Central Environmental Authority (CEA) of the MOE was designated as the implementing body.

The APELL project in Sri Lanka had two aims

1. to build the capacity and raise the awareness of national authorities and local level institutions on how to better prevent and prepare for disasters and
2. to support the implementation of an APELL demonstration in KEPZ, Koggala and the Industrial Zone in Ekala with the effective participation of representatives of the industrial community, the local level government institutions and the local community.

The ultimate goal of the APELL project is 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 at the two sites by building their capacity to properly coordinate to be better prepared to react to disasters.

APELL process conducted in Sri Lanka was based on the APELL 10 steps as outlined in the APELL handbook and the following key tasks were implemented during the project period:

1. One-day National Seminar to launch the APELL project and to raise awareness among key high-level government stakeholders,
2. One-day APELL training for the Local Coordinating Groups,
3. One-day APELL training of trainers session for the Resource Persons identified and other key experts from academia and local level government institutions,
4. Two training sessions on APELL of three days each for the local level institutions, the local emergency services, key representatives of the industry and key community representatives,
5. Two APELL site demonstrations in Ekala and Koggala,
6. Development of integrated emergency preparedness plans for two sites,
7. Translation of APELL technical materials into other national languages (Sinhala and Tamil languages).

The APELL initiative succeeded in ensuring national level government support for the APELL implementation in line with the National Disaster Management Strategy of the Disaster management Centre (DMC) because of the formation of the APELL Core Group comprising of high ranking officers of all stakeholder institutions.

The close coordination and the intimate mutual relationship maintained with these agencies throughout the project period were helpful in many ways and result in the achievement of the project objectives.

The APELL project took initiative in raising awareness and preparedness for emergencies with respect to industrial hazards. This has been emphasized in the 'Road Map for Disaster Risk Management' prepared by the DMC which is a guiding document for Disaster Management in Sri Lanka.

Residential training programs and Local Coordinating Group meetings conducted regularly at each site have established close relationship amongst the three components (local level institutions, industrial community and local communities) and also helped to develop consciousness, team spirit and to build consensus to reach a common target. The Integrated Emergency Preparedness Plans prepared for KEPZ and EIE has been very significant achievement of the APELL project.

In view of the importance of the APELL material in terms of its technical content, the Department of Engineering of the University of Moratuwa, Sri Lanka decided to include the APELL training module on 'emergency planning' in the University curriculum and this too was a great achievement of the APELL project.

P 5.3 Projects of the UNECE Convention of the Transboundary Effects of Industrial Accidents to Support Prevention, Preparedness and Response to Natechs

SP5.3 Chris DIJKENS (Chair of the Conference of the Parties to the UNECE Convention of the Transboundary Effects of Industrial Accidents)

The presentation is to briefly introduce the projects under the Convention 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.

In particular, the presentation is to mention:

- Project on evaluation of safety reports and on-site inspections during which checklist to support evaluation of safety reports and preparation for inspections was prepared and which addresses the aspects crucial in dealing with Natechs;
- Project on hazard and crisis management in the Danube Delta, which promotes further strengthening of safety at oil terminals through improved cooperation of Danube Delta countries, including taking into consideration the aspects of natural hazards: for hazard management through use of checklist for safety assessment of facilities hazardous to waters – water risk index taking into account natural hazards, for crisis management through exercises with scenarios taking into account natural hazard;
- Project on identification of hazardous activities, which promotes the approach of worst-case scenario analysis;
- Projects through which safety guidelines and good practices for pipelines and tailing management facilities were developed which address the aspects crucial to Natechs for both types of facilities.

V b Presentation V.4 – V.5: International Assistance

P5.4 International Chemical Environment

SP5.4 Jos VERLINDEN (cefic)

The chemical industry has an excellent track record in transport safety and makes every effort to transport its goods in a safe way. In case of a chemical transport accident, the industry provides information and advice, and, if possible practical assistance to emergency services to minimise adverse effects. Normally the company owning the product will provide this information and assistance but if this is not possible, the emergency services can activate the European ICE (Intervention in Chemical transport Emergencies) scheme of mutual assistance.

The ICE scheme, coordinated by Cefic, is based on a European network of national response schemes, each based upon an agreement between the national authorities and the national chemical association. Such schemes use the voluntary commitment of companies, willing to provide mutual assistance in transport accidents, upon requests from the public emergency services. The national schemes are managed by the respective national chemical associations.

Participating companies provide to the national chemical association up-to-date contact data, the list of products for which they can assist and the level of assistance offered (by phone or on site with or without equipment).

At present, national schemes have been established in 17 countries, each with a national centre, hereby involving more than 600 chemical companies, and covering all goods that are classified as dangerous for transport by ADR (European Agreement concerning the International Carriage of Dangerous Goods by Road).

The total number of interventions provided by the 17 national schemes is approximately 2,200/year of which 50 involve assistance across national boundaries.

P5.5 The Hazard Identification Tool (HIT) – a Tool to Identify and Address Secondary Environmental Risks

SP5.5 Dennis BRUHN (OCHA Environmental emergencies section)

Natural disasters and conflicts often have secondary impacts, including damage to infrastructure and industrial installations. These so-called environmental emergencies may pose a threat to the health, security and welfare of both the affected population and the emergency responders. Too often, these risks are neglected, resulting in preventable deaths and injuries. It is, therefore, essential that relevant authorities and emergency responders have information on the location of the hazardous facilities and the potential impacts at a very early stage of the disaster response.

Countries that have developed a national disaster plan that includes a national environmental contingency plan will have this information available for relevant authorities and emergency responders prior to the onset of a disaster. These countries will respond both more quickly and more effectively to environmental emergencies within their borders. This information will then contribute to targeted mitigation measures and requests for further specialized assistance if needed.

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 or a conflict and as a basis for on-site investigations and field assessments. The HIT is based on the methodology of the Flash Environmental Assessment Tool (FEAT), a scientific assessment methodology to detect the most acute hazards to human health and the environment after natural disasters. The FEAT and the HIT both use the same framework for estimating the type of impact of each identified risk. (Impact type is recorded in the fifth column of the HIT form – see below.) Both the FEAT and the HIT are typically used together in the international response to environmental emergencies. The HIT provides a list of big and obvious potential secondary risks in any area that might experience natural disasters or conflicts. This includes large infrastructure installations like dams, nuclear facilities, hazardous waste storage sites and industrial facilities.

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Dresde, Germany

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