EUROPEAN COMMISSION
DIRECTORATE-GENERAL
Joint Research Centre

Analysis of Natech (Natural Hazard Triggering Technological Disasters) Disaster Management

NEDIES Workshop Proceedings
Ispra, Italy, 20 – 21 October 2003

Editors:
Ana Lisa Vetere Arellano
Ana Maria Cruz
Jean-Pierre Nordvik
Francesco Pisano

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Technological and Economic Risk Management Unit

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We would like to thank Dr. Ana Maria Cruz and Prof. Laura Steinberg for allowing us to use the photos published on the cover page of the present report.

About NEDIES (Natural and Environmental Disaster Information Exchange System)

The NEDIES project is being conducted at Ispra by the Institute for the Protection and Security of the Citizen (IPSC) of the EC Directorate General Joint Research Centre (JRC). The objective of the project is to support the Commission Services of the European Communities, Member State Authorities and EU organisations in their efforts to prevent and prepare for natural disasters and accidents, and to manage their consequences.

One of the major NEDIES activities is to provide a platform of exchange of experiences and ideas on natech disaster risk management. It is based on the contributions presented at a NEDIES Workshop *Analysis of Natech (Natural Hazard Triggering Technological Disasters) Disaster Management*, held in Ispra, Italy on 20 and 21 October 2003, which was jointly organised by the United Nations International Strategy for Disaster Reduction and the European Commission DG Joint Research Centre, Institute for the Protection and Security of the Citizen.

FOREWORD

There is sound evidence that natural disasters can trigger technological disasters (a dynamic also called *domino effect*), and that these concomitant events (also known as natechs) may pose tremendous risks to countries and communities that are unprepared for such risks. In Europe there are many vulnerable installations close to rivers, or located in earthquake prone areas, or subject to other kinds of natural hazards, thus potentially prone to their impacts. The recent floods across Europe in the summer of 2002 are an example showing the potential danger of natech disasters occurring near populated areas. This was the case, for example, in the Czech Republic and in Germany where rapid response by Civil Protection Authorities prevented disasters of vast proportions. Because of the threat posed to society and the environment by this domino effect, the NEDIES project has launched a research activity in this area to assess the state-of-the-art of natech risk management in the European Union (EU) and Candidate Countries, as well as identify needs and assist actors and stakeholders in identifying and prioritizing strategies for natech risk reduction. Because of the importance of this area of investigation and application, the United Nations International Strategy for Disaster Reduction (ISDR) and JRC choose to collaborate in the study of the problem and identification of potential solutions in the framework of a collaboration agreement for the period 2003-2006.

This undertaking is underpinned by the clear need to better understand the relationship between natural and technological hazards and their combined impacts in the short, medium and long term. The results of this initiative will be used to optimise prevention strategies, level of preparedness, existing mechanisms of response to face natech risks in Europe, including methods of information to the public. In parallel, this new initiative is fostering wider discussion regarding natech disaster risk management and exchange of experiences in order to deal holistically with multi-hazard scenarios that often have a transboundary dimension, which is of concern to European Union.

In this context, the NEDIES workshop on "Analysis of Natech Disaster (Natural Hazard Triggering Technological Disasters) Management" was organised by the NEDIES team of the European Commission (EC) Directorate General Joint Research Centre (JRC), Institute for the Protection and Security of the Citizen (IPSC), in Ispra, Italy, on 20-21 October, 2003 in collaboration with the United Nations Secretariat for the International Strategy for Disaster Reduction. Participants in the workshop included thirteen representatives from EU, Accession, and Candidate countries from the respective Civil Protection Authorities, representatives from the research community in Japan and the United States, and representatives from the JRC and the UN/ISDR. Participating Candidate and Accession countries included Bulgaria and Romania, and Cyprus, Lithuania, and Hungary, respectively. Appendix 1 contains a detailed list of participants.The objective of the workshop was four fold, and included:

- To create awareness of the potential for joint natural and technological disasters (natechs), by better characterizing the natech phenomenon in relation to the various potential hazards on a given territory.
- To better understand the state-of-the-art in natech disaster risk management in Europe.

- To provide an inter-disciplinary platform where experiences and methodologies pertaining to natech disaster risk management could be shared amongst interested parties.
- To identify needs and synergies in the area of natech disaster risk management and propose a set of key strategies for future natech risk reduction where NEDIES and ISDR can assist stakeholders.

One of the main outputs of the workshop is the production of these proceedings, which portrait a wide array of knowledge and experience from the various participating countries regarding natech disaster risk management. The workshop was but one stepping stone in the efforts being made in this important areas by JRC and by the United Nations, and more recently, by both entities in a promising collaboration spirit.

Jean-Pierre NORDVIK
European Commission – DG JRC

Francesco PISANO
United Nations - ISDR

ACKNOWLEDGEMENTS

The editors would like to thank all the participants (see Annex 1 – List of Participants) of the NEDIES Workshop *Analysis of Natech (Natural Hazard Triggering Technological Disasters) Disaster Management*, jointly organised by the United Nations International Strategy for Disaster Reduction and the European Commission DG Joint Research Centre, Institute for the Protection and Security of the Citizen, held in Ispra, Italy, on 20 - 21 October 2003, at which the contributions to these proceedings were presented. They are specially acknowledged for their participation in the discussion and suggestions.

Prof. Laura Steinberg is also acknowledged for her valuable contributions before and during the workshop. Raffaella Magi-Galluzzi and Pamela Muscillo are also warmly thanked for their their assistance during workshop.

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Introduction

This EUR report has brought together the contributions of thirteen representatives from EU, Accession, and Candidate countries from the respective Civil Protection Authorities, along with representatives from the research community in Japan and the United States, who all participated in the NEDIES Workshop

It can be noticed that the contributions to the proceedings are divided into three parts:

i) *Keynote papers (Section A)*, which portrays four contributions. The first is from Italy regarding the storm that triggered a blackout written by Dr. Marta Di Gennaro, the Director General of the Italian Department of Civil Protection. This is followed by the paper on the August 1999 earthquake that occurred in Turkey, prepared by Dr. Ana Maria Cruz, the UN/ISDR secondment to the NEDIES project from Colombia. Next is the paper by Mr. Tetsushi Kurita of the Asian Disaster Reduction Center on the recent Earthquake in Japan in September 2003. The last entry to this section of the proceedings is from Prof, Laura Steinberg of Tulane University, USA, which addresses natechs in the United States.

ii) *Country papers (section B),* which provides seven papers addressing natech-related issues in the following countries: Italy, Bulgaria, France, Germany, Portugal, Romania and Sweden.

iii) *Country presentations (Section C),* which show the PowerPoint presentations of natech-related activities in six countries in Europe: Austria, Cyprus, Finland, Hungary, Lithuania and the Netherlands. Due to various constraints, these countries were unable to provide a paper based on their presentations.

The workshop included plenary sessions and parallel working sessions during both days. There was an opening session by the JRC and the UN/ISDR, followed by presentations by invited keynote speakers, and a series of individual country presentations. These presentations were followed by a day and a half of parallel working sessions, where the country representatives were divided into two groups, and worked together as a group to address a series of questions concerning natech disaster impacts, vulnerability, and risk reduction. The individual workgroups then convened in a plenary session at the end of each day to present the workgroup results and allow for discussion. See the Section entitled: *PARALLEL WORKING SESSIONS AND RESULTS* for the Parallel Session Description and Working Sessions Results. Appendix 2 provides the Workshop Programme.

Section A: KEYNOTE PAPERS

A1 – The Black-Out of 28 September 2003

Marta DI GENNARO (Director General of the Department of Civil Protection)
Presidency of the Council of Ministers, Via Ulpiano 11, I – 00193, Rome, ITALY
marta.digennaro@protezionecivile.it

Abstract

This contribution briefly describes the black out that hit the Italian peninsula on 28 September 2003. It is an example of a natural hazard that triggered a technological disaster, i.e. the blackout. It is based on a presentation given during a workshop entitled Analysis of Natech (Natural Hazard Triggering Technological Disasters) Disaster Management.

Keywords : blackout, emergency response, civil protection, Italy

THE FACTS

3:01 a.m.: in a fraction of a second Italy lost more than 6000 MW of power – more than 25% of its total consumption requirement.

According to the National Distributor, Italy's electrical system shut down as a form of automatic protection, thus provoking a black-out. The Italian network detached from the European network in only four seconds' time. Our system did not hold up. This was an exceptional event and the chief officer of National Distributor has stated that there was nothing that could have been done.

The Italian electrical system is very vulnerable as a result of its heavy dependence on importation from abroad (equal to 6,300 MW – the highest of all the 15 EU Member States).

Emergency phases

3:01 a.m. *Breakdown*: as a result of high winds, a spruce-fir tree falls onto the Matten-Lavorgo electrode in Brunnen, Switzerland, cutting electrical power on a line supplying Italy with 1,320 MW.

3:11 a.m. *Advisory*: Etrans, coordinator for Swiss distributors, advises their Italian colleagues at GRTN (National Distributor) of the breakdown and asks for a reduction in the importation of electrical power.

3:13 a.m. *Reduction*: GRTN reduces its importation of power from abroad from 6,400 to 6,200 MW. The problem seems much less serious at first and to be a question of adjustment.

3:20 a.m. the lights go out all over Italy

Immediate interventions

Effects on the Italian health system:

i) The power outage is felt within minutes in the hospitals All operating rooms in which particularly demanding surgical operations are underway continues to function as electricity generators go into function immediately, which also resolves the problem of patients connected to life-support equipment.

ii) Four babies are born during the black-out.

iii) The Fire and Police Departments supply diesel fuel to hospitals upon request.

iv) Fire Departments handle assistance to patients dependent on respirators at home.

Calls to Emergency Intervention Numbers

There are 59,000 calls for intervention on the night of the black-out. The Fire Departments dispatch 3,593 calls. Out of a total of 1,421 special rescue calls, 382 are for road accidents.

Forces deployed

8,750 teams of State Police and Gendarmes

4,000 Railway Police units in 280 stations

1,360 Motorway Police patrols

Tens of thousands of volunteers

Inconveniences

<u>Airports</u>: no overwhelming inconveniences are registered. Out of a total of 800 arriving and departing flights only six are cancelled. Accumulated delays amount to two hours.

<u>Ferry Service</u>: passenger inconveniences are limited. Accumulated delays amount to one hour.

<u>Railways</u>: a total of 110 trains and 30,000 passengers are involved. Passengers suffer considerable inconvenience as stations are left in complete darkness and travel is interrupted. The greatest inconvenience is experienced by the 500 passengers booked on Unitalsi's "white train", who are left waiting many hours in the Latina station for their train, which is unable to depart from Rome's Tiburtina station.

<u>Metropolitan Transit</u>: the greatest level of inconvenience is registered in Rome where a special event being held for the first time, known as the "Notte Bianca" (the city stays open all night), is underway. Metro trains are packed with passengers taking advantage of the all-night events, and who are forced to reach the nearest stations on foot.

<u>Elevators</u>: many people are trapped in elevators and have to wait hours for rescuers to intervene.

<u>Commerce</u>: foodstuffs go bad as a result of refrigerators shut down.

Civil Protection Department solutions

The Civil Protection Department (CPD) sends out a series of advisories via text message regarding how to avoid inconvenience and accidents (to not use trains and cars and to listen to the battery operated radio for information). The CPD's Operative Committee unceasingly monitor the situation across the entire country by means of direct links with all the Prefectures. The most vulnerable facilities appear to be the hospitals with alternative sources of electricity incapable of supporting lengthy interruptions of power. Another weak point is rail transport, with trains arrested at unspecified points along various routes.

Mobile telephone service also presents some blind spots as many areas of the country are left without signal reception.

The Italian islands were excluded from the emergency situation, including Capri.

Information

One of the most evident problems is the inaccessibility of information. The only contact with the world is via battery-powered radio, which becomes as indispensable a tool in confronting the emergency as the flashlight.

Civil Protection Plan

The Civil Protection Plan for dealing with the crisis is implemented with the maximum rapidity and efficiency, but great merit must also be given to the citizens, whose calm, composed behaviour so favoured the work of those intervening to bring the situation back to normal.

By the morning of 28 September electrical power is already returning to various areas of Northern Italy; in Central and Southern Italy instead the scenario remains critical until late afternoon. While the situation gradually returns to normal, the Head of the Civil Protection Department, Guido Bertolaso, recommends limited use of household appliances since the risk of another black-out at the moment in which power is restored remains high.

The emergency status ends on the morning of 29 September. Confirmation is issued at the conclusion of a meeting of Civil Protection technicians and electrical network distributors and managers, who provide a reassuring picture: normality has been re-established in almost the entire country, with the persistence of only a few "small inconveniences" owing to the long absence of electrical power.

The Civil Protection Department can now step out of the picture: another crisis situation overcome.

In closing, Figure A1.a shows the Italian peninsula BEFORE the Italian blackout struck, whilst Figure A1.b depicts the situation during the blackout.

Figure A1.a – The Italian peninsula before the blackout struck on 28 September 2003.

Figure A1.b – Italy with respect to other European countries during the black out of 28 January 2003.

A2 – Cascading events and hazardous materials releases during the Kocaeli Earthquake in Turkey

Ana Maria CRUZ (UN/ISDR scientific expert secondment to the NEDIES team)
Department of Civil and Environmental Engineering, Tulane University
New Orleans, LA 70118, USA
acruz@tulane.edu

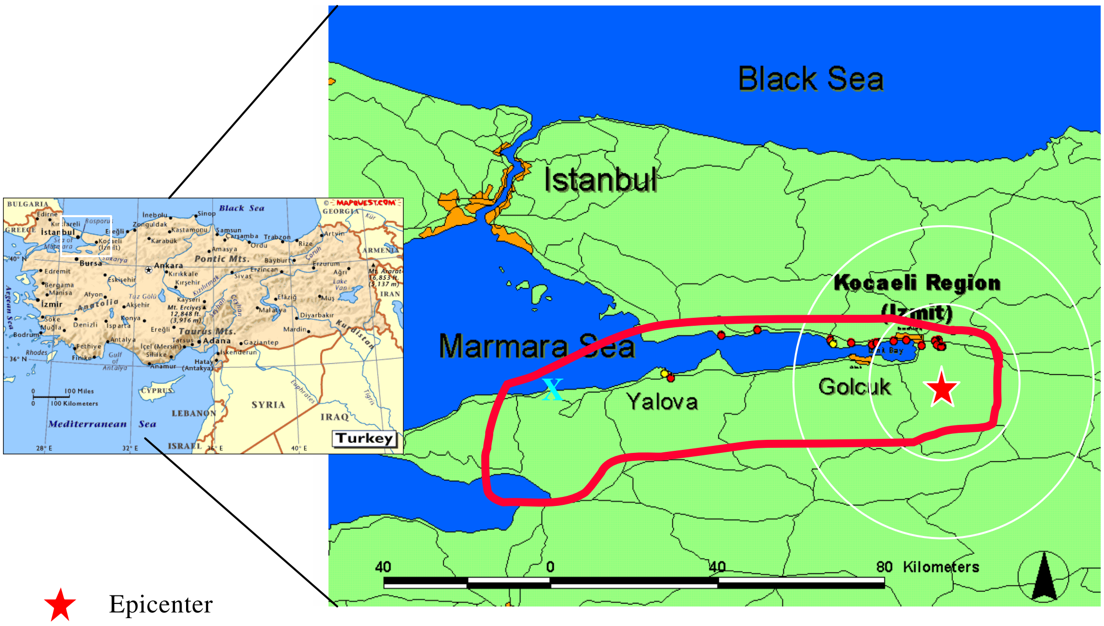
Abstract

The Turkey earthquake of August 17, 1999 offered a unique opportunity to study cascading events and hazardous materials releases during strong ground motion. While there has been some attention devoted to releases from pipeline breaks during earthquakes, until recently there has been little consideration of earthquake-related hazardous materials releases at industrial facilities. This paper results from a study of hazardous material releases in 19 industrial facilities in the industrial region of Kocaeli, Turkey, one of the hardest hit areas. The study used interviews and visits to these industrial facilities to investigate the triggering mechanisms and cascading events which lead to or followed the hazardous materials releases which were identified. The performance of hazmat mitigation measures and emergency response to the hazmat releases in the context of the earthquake were also investigated. Interviews of government officials in charge of industrial risk management and emergency response were also carried out.

Keywords : 1999 Turkey earthquake, Kocaeli, natech, emergency response, hazmat. Mitigation, emergency response

1. PROCEDURES OF DAMAGE ESTIMATION

The magnitude 7.4 earthquake in Kocaeli, Turkey in August 17, 1999 resulted in over 17,000 deaths and more than 40,000 people injured. Thousands of residential and business units were damaged, and more than 350 industrial facilities in Kocaeli reported damage to their plants. In addition, the earthquake triggered large fires, toxic air releases of dangerous substances and oil spills at several industrial facilities. Figure A2.a shows the epicentre of the Kocaeli earthquake, along with the location of industrial facilities visited for the study.



★ Epicenter

▬ Zone where Modified Mercalli Intensity Scale (MMI) was X

Figure A2.a - Map depicting the epicentre of the Kocaeli earthquake of August 17, 1999 and the location of industrial facilities visited for the study.

The earthquake was one of the first earthquakes in modern times to strike a highly urbanized and industrialized region. Kocaeli is one of the most densely populated regions, and accounts for 30% of industrial production in Turkey.

Thus, the Kocaeli earthquake offered an opportunity to learn first hand about the effects of strong ground motion on hazardous materials stored, used or handled at industrial facilities in the region, and to assess the effectiveness of risk management and emergency response practices for earthquake-triggered hazardous materials releases in the context of the earthquake.

2. METHODOLOGY

Data for this study was obtained through a series of interviews and visits at nineteen industrial facilities in the affected region subject to Modified Mercalli Intensity of X. Using a survey instrument the study asked aobut the hazmat stored or used at each facility and whether any hazmats were released during the earthquake. Questions regarding the triggering mechanisms and cascading events which lead to or followed the hazardous materials releases were also posed. The performance of hazmat mitigation measures and emergency response to the hazmat releases in the context of the earthquake were also investigated. Interviews of government officials in charge of industrial risk management and emergency response were also carried out.

3. RESULTS

3.1 Earthquake Effects

Eighteen of nineteen industrial facilities reported damage to their plants. Hazmat releases were reported at 14 (of 19) facilities, eight of these industrial facilities reported substantial hazmat releases with offsite consequences. A total of twenty one hazmat incidents were documented. Examples of hazmat releases include the release of 50,000 kg of crude oil into Izmit Bay, the release of 1.2 million kg of cryogenic oxygen, the spill of 100,000 kg of phosphoric acid, and three simultaneous independent fires at an oil refinery (Steinberg and Cruz 2003).

Problems with lifeline systems and onsite utilities were also reported. A total loss of electrical power and communications capabilities were reported in all facilities. All facilities reported problems with water supply, while five suffered loss of onsite emergency water. Furthermore, insufficient personnel to respond to hazmat releases were reported at all the plants that suffered hazmat problems.

3.2 Risk Management Practices at the Time of the Earthquake

The industrial facilities visited had taken some prevention and mitigation measures for chemical accident prevention. Seven (of 19) facilities reported structural design or retrofitting for earthquakes. Twelve (of 19) facilities reported the use of anchoring mechanisms for tanks and equipment, while almost all (17 of 19) reported the use of restraining straps or chains for securing pressure cylinders and barrels containing dangerous substances. Nonetheless, during the site visits unsecured hazmat containers were observed in many of the facilities. All of the facilities visited had containment dikes around storage tanks, and internal drainage systems and waste water treatment plants. Additionally, they all had back-up power generators and emergency water systems.

3.3 Emergency Response to the Hazmat Problems during the Earthquake

Emergency response to the earthquake-triggered hazardous materials problems were imbued with many problems. Although safety and emergency response measures for accidental chemical releases existed, they were not designed to operate in the aftermath of a large earthquake or to withstand EQ forces. Industry emergency response plans for chemical accidents did not address hazmat releases during earthquakes, therefore considerations on how to respond to the earthquake triggered fires and hazmat spills in the absence of water, electrical power, and communications had not been properly analyzed. Furthermore, there were very little workers and emergency response personnel available. Panic behavior in the form of "flight away from danger" was blamed for emergency response deficiencies by almost all people interviewed at the industrial facilities visited.

3.4 Analysis of Cascading Events Triggered by the Earthquake

The Kocaeli earthquakes caused secondary disasters, such as multiple hazardous material (hazmat) releases and fires described above, through a series of direct and indirect cascading events. The cascading events included various mechanisms and failure paths, in some cases involving the intersection of highly improbable and independent events. Cascading failures helped exacerbate the difficulties in responding to the joint natech events.

The following example illustrates the cascading events that were triggered by the earthquake in the naphtha tank farm at an oil refinery in Kocaeli:

- Vibration of the floating metal roofs against the tank shells creates sparks that ignite four naphtha tanks;
- Simultaneously, the earthquake damaged a flange connection on one of the burning naphtha tanks;
- Naphtha leaks through the damaged flange;
- The Naphtha leakage from the damaged flange ignites;
- The ignited naphtha flows downstream through a drainage canal;
- The fire spreads through the drainage canal to two additional tanks;
- Damages to power lines and main water pipelines delay fire fighting efforts;
- The large fires pose a threat to nearby storage tanks containing liquefied petroleum gas (LPG) and ethylene;
- The threat of explosion of LPG tanks threatens anhydrous ammonia storage tanks in nearby fertilizer plant. Due to the threat, an evacuation of 5 km area is ordered only 12 hours after the quake, and 200 tons of ammonia are intentionally released.
- Search and rescue is abandoned in evacuated areas.

These events are mapped in Figures A2.b and A2.c.

The earthquake triggered cascading events that led to hazmat releases and that affected the capacity to respond to the hazmat releases. Furthermore, the hazmat releases triggered other hazmat problems, and threatened other industrial facilities in the region, and had a negative effect on search and rescue of earthquake victims. Figure A2.d depicts the series of emergency response problems encountered at the oil refinery in trying to respond to the multiple fires and hazmat releases during the earthquake.

Similar events were experienced by an acrylic fibre plant in Yalova during the earthquake. The earthquake triggered the exposure and spill of 6.5 million kg of highly volatile acrylonitrile from three (out of 8) storage tanks. Figure 5 diagrams the cascading events triggered by the earthquake at the acrylic fibre plant.

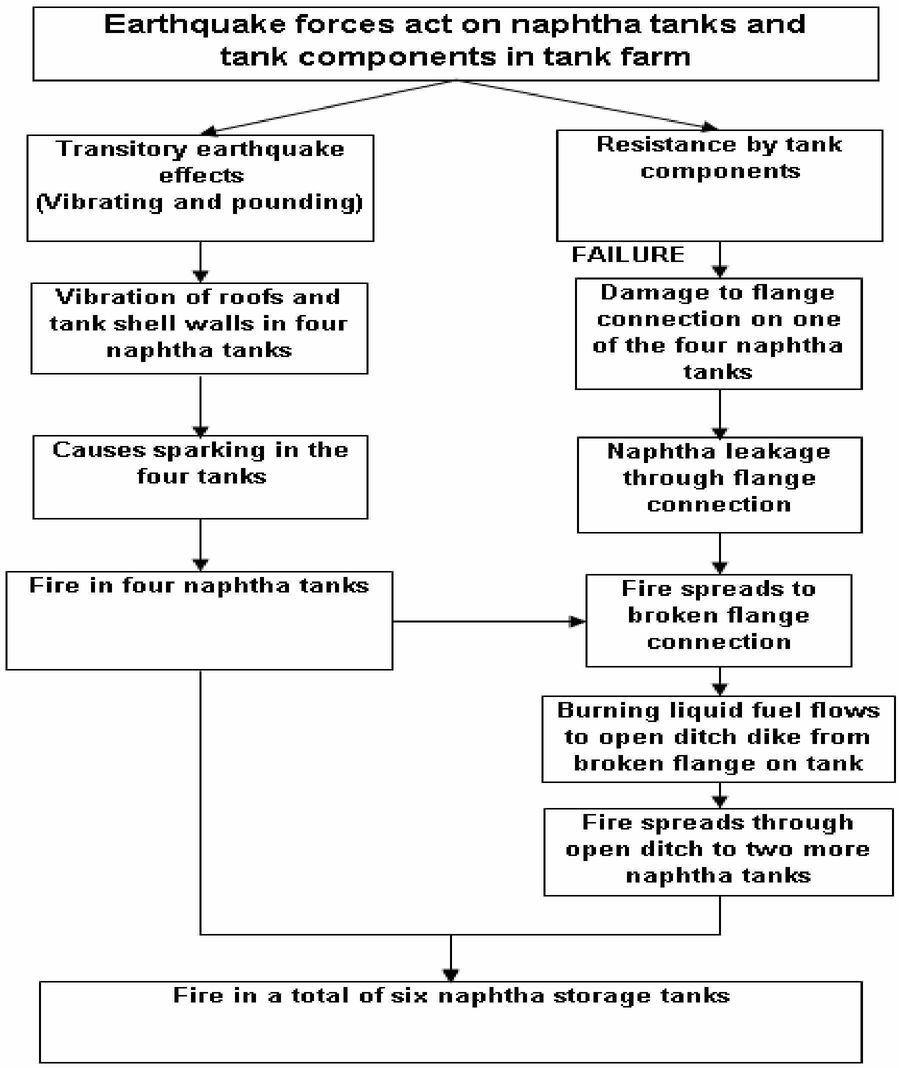


Figure A2.b - Earthquake triggered cascading events at the naphtha tank farm.

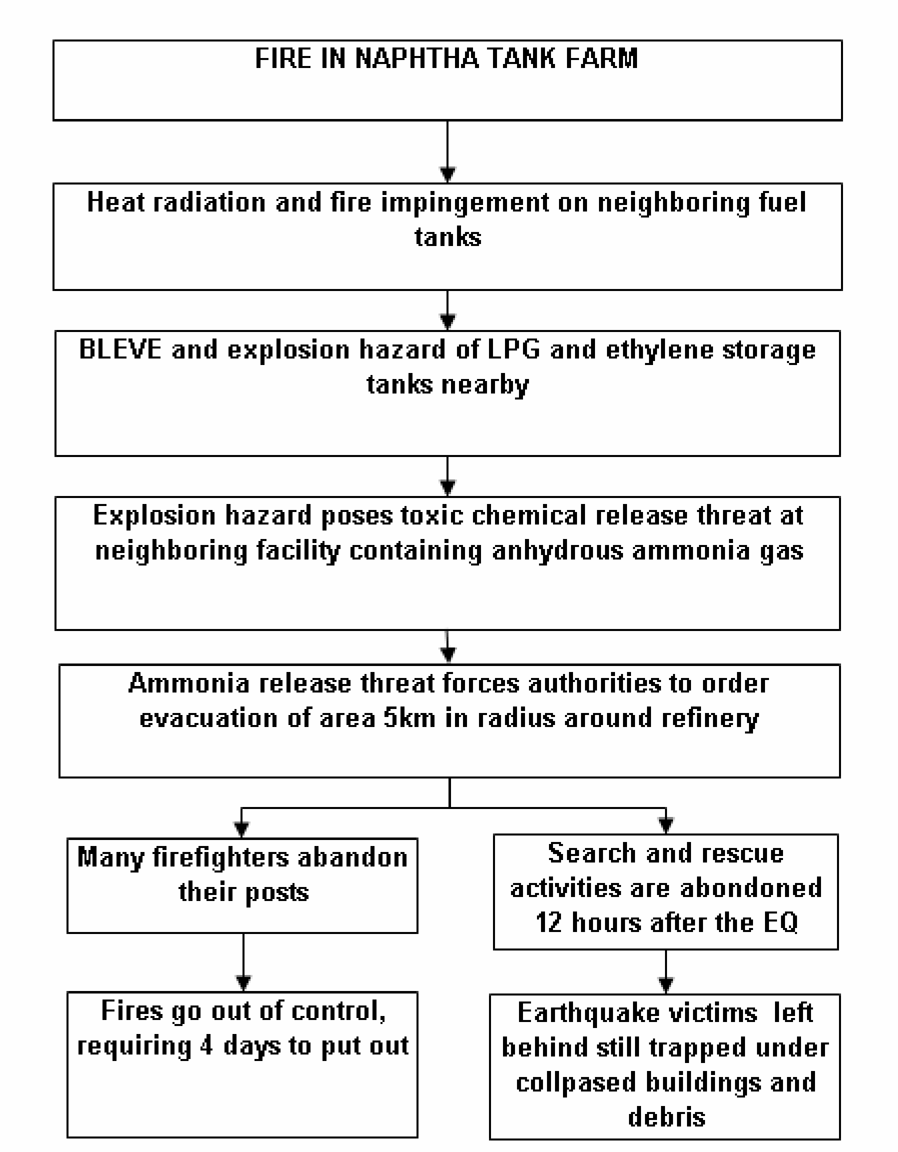


Figure A2.c - Offsite and onsite consequences of naphtha tank fires.

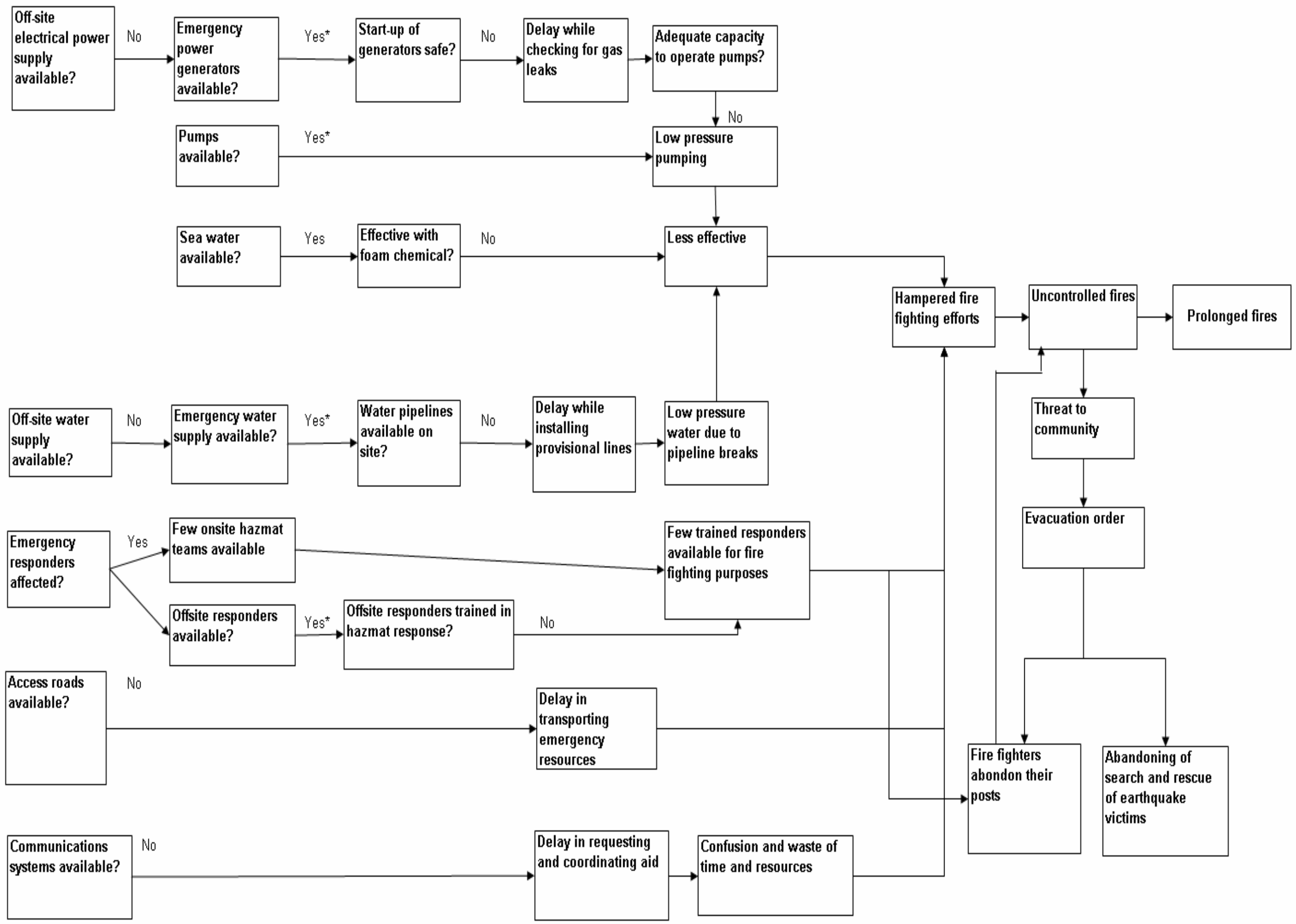


Figure A2.d - Cascading events which hampered emergency response to the multiple fires and hazmat release at an oil refinery following the Kocaeli earthquake.

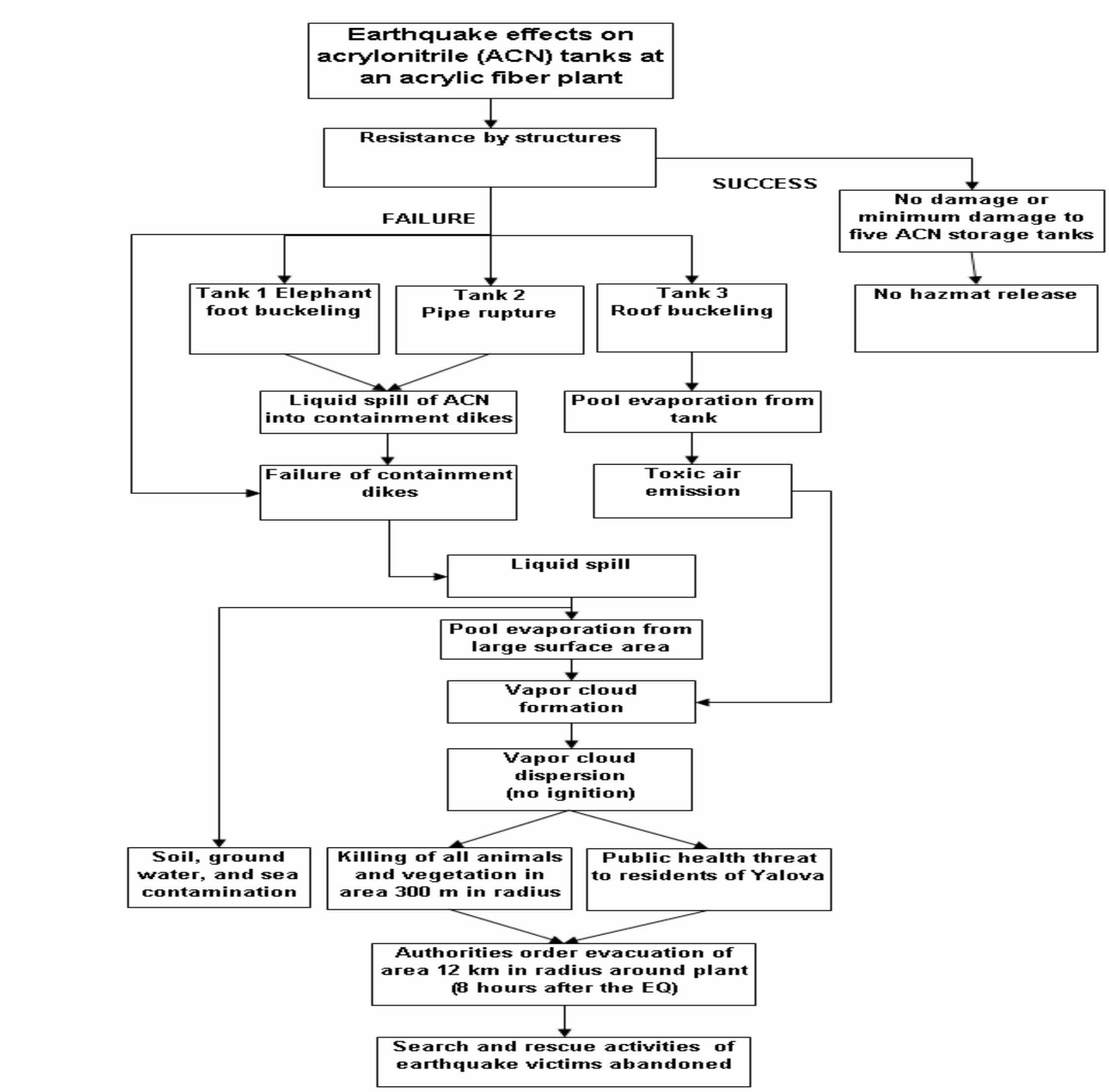


Figure A2.e - Earthquake effects on acrylonitrile storage tanks at the acrylic fibre plant.

DISCUSSION AND CONCLUSIONS

The Kocaeli earthquake in Turkey confirmed that an earthquake acts as a common force capable of initiating multiple and simultaneous independent events which combined can result in devastating consequences. The main problems identified with respect to natech risk management and emergency response include:

- Seismic design considerations were generally not applied to safety and mitigation measures.
- Safety and mitigation measures were designed was based on the availability of lifelines. That is they were designed to prevent and respond to hazmat accidents during normal day-to-day plant operation.
- Emergency response (ER) plans for hazmat releases considered one hazmat incident at a time. Single or multiple events from one or more sources were not considered, therefore emergency was inadequate.

- The proximity of the industrial facilities to urban areas affected not only nearby residential areas, but also neighboring communities.
- The natech disasters posed additional health and psychological problems to an already devastated population.
- Local emergency management officials were unprepared to respond to multiple hazmat releases and chemical accidents. The hazmat problems used up much needed resources to respond to earthquake victims.

The Kocaeli earthquake showed that the consequences of natechs can be higher in large metropolitan areas because there are more people and infrastructure at risk. In this context, analysis of vulnerability to natechs in large urban areas is essential for natech risk reduction.

The study findings show that the analysis of external hazards such as earthquakes must be carried out and incorporated in plant design. However, this may not be sufficient, unless industrial risk management and emergency response measures are also designed to operate in the absence of water or electrical power which is common during earthquakes.

Those in charge of community disaster prevention and preparedness must be made aware of the potential dangers associated with natech hazards so that they may be prepared to respond to these types of events. Identifying potential release scenarios will help in emergency preparedness planning for multiple and simultaneous events.

Finally, addressing natechs will require that people typically working in industrial and technological risk management work together with those involved in natural disaster risk reduction.

REFERENCES

Steinberg, L. J.; and A M. Cruz, (2003). "When Natural and Technological Disasters Collide: Emergency Management Lessons From the Turkey Earthquake of August 17, 1999". In Press in *Natural Hazards Review*.

A3 – Observation on the Recent Earthquake Damage in Japan

Tetsushi KURITA
Asian Disaster Reduction Center
New Hitomiraikan 5F., 1-5-2 Wakinohamakaigan-dori,
Chuo-ku, Kobe 651-0073, JAPAN
kurita@adrc.or.jp

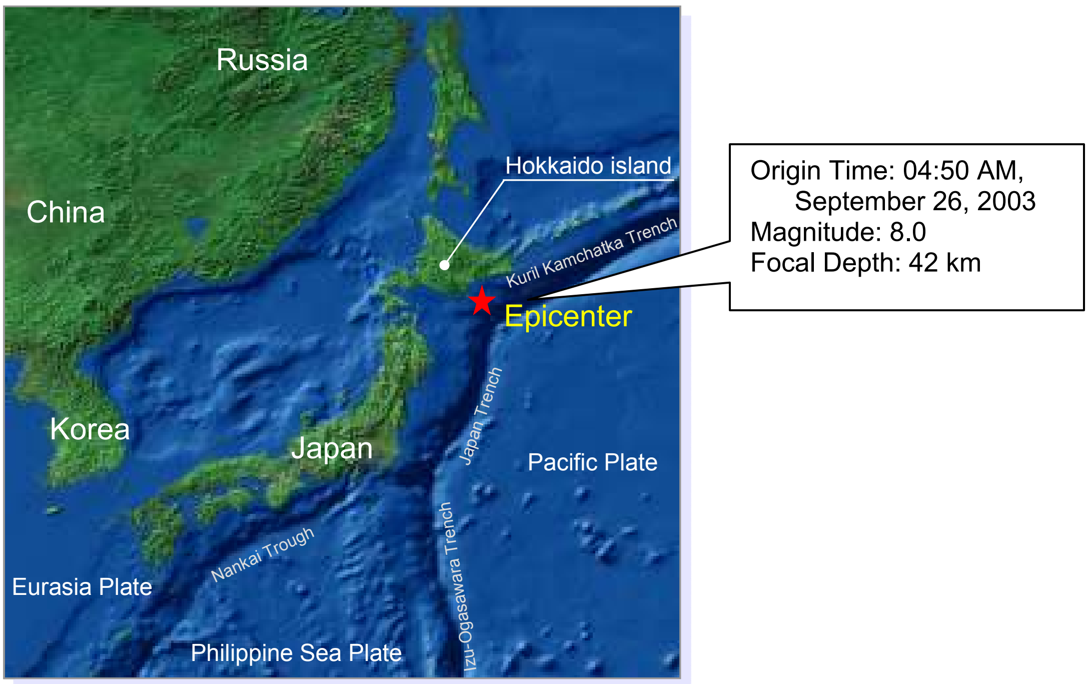
Abstract

On September 26, 2003, a large earthquake struck the northern island of Japan. It was named the 2003 Tokachi-oki earthquake. Japanese local magnitude of the earthquake was 8.0 on the Richter scale and the maximum JMA (Japan Meteorological Agency) seismic intensity was 6 lower. This earthquake caused tsunami that recorded the highest of 1.3 m at a tidal observatory and 4.0 m of its trace was identified in the later survey. Damage due to earthquake was comparatively small except infrastructure. The most serious damage was oil storage fire. This oil storage fire caused social ferment.

Keywords: 2003 Tokachi-oki earthquake, tsunami, earthquake damage, oil storage fire, surface wave

1. INTRODUCTION

On September 26, 2003 at 4:50 a.m., a large earthquake struck the northern island of Japan, Hokkaido. Basic information of the earthquake is shown in Figure A3.a. The epicentre was located in the offshore of south-eastern Hokkaido with the 42 km focal depth. It was named the 2003 Tokachi-oki earthquake. Japanese local magnitude of the earthquake was 8.0 on the Richter scale and the maximum JMA (Japan Meteorological Agency) seismic intensity was 6 lower. This earthquake caused tsunami that recorded the highest of 1.3 m at a tidal observatory and 4.0 m of its trace was identified in the later survey.



A3.a - Basic information on the earthquake.

Figure A3.b shows probability of the occurrence of large earthquakes within 30 years from the stipulated reference date. Japanese Government is preparing an evaluation of long-term probability of large earthquake occurrence within 30 years. Until now, 11 earthquakes along the plate boundaries have been examined and declared. The occurrence of Tokachi-oki earthquake with magnitude 8.1 was estimated as 60 %. The earthquake occurred in last month is considered as this estimated earthquake.

Figure A3.c indicates a distribution of horizontal displacement of crust observed by GPS (Global Positioning System). The area close to the focal region moved to south-east direction due to crustal deformation caused by the earthquake. All displacement vectors look toward the Kuril-Kamchtka trench. The maximum displacement is 87 cm. It means the rebound of upper plate in the subduction zone.

This earthquake induced a tsunami. It affected the coastal area. Distribution of tsunami height is displayed in Figure 4. Red bar means the record at tidal observatory. Yellow bar indicate the trace of tsunami at port. Pink bar shows the trace of tsunami at beach. The maximum height was 4.0 m surveyed at Erimo cape.

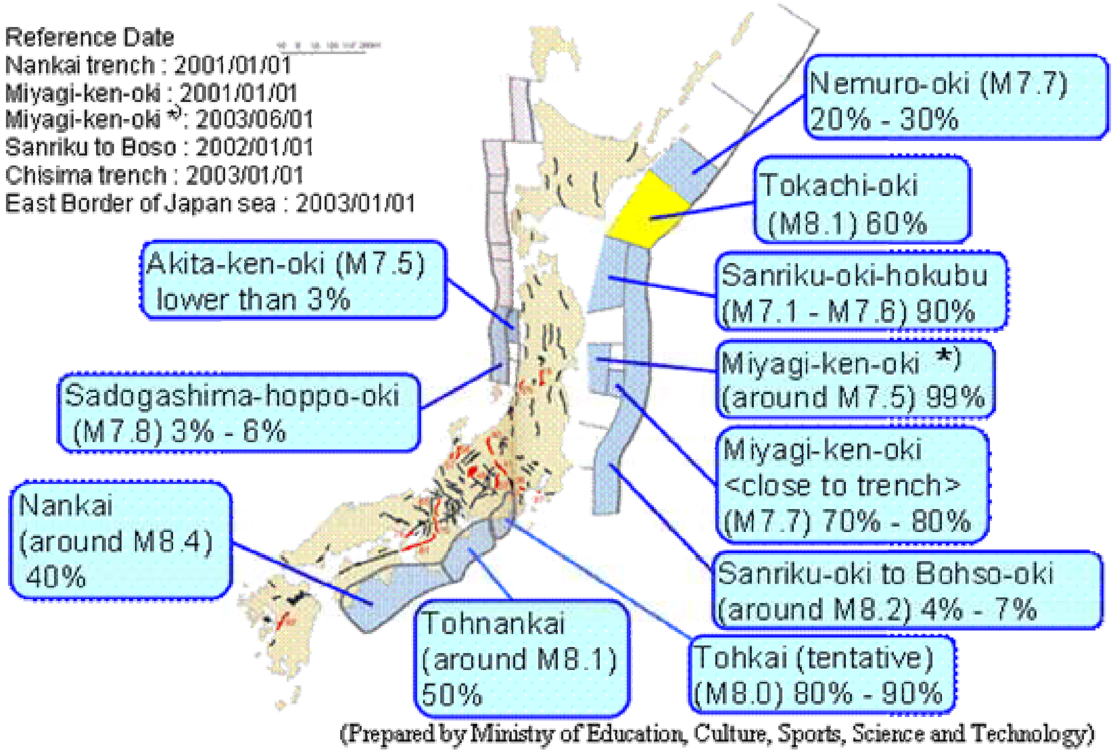


Figure A2.b - Probability of the occurrence of large earthquakes within 30 years.

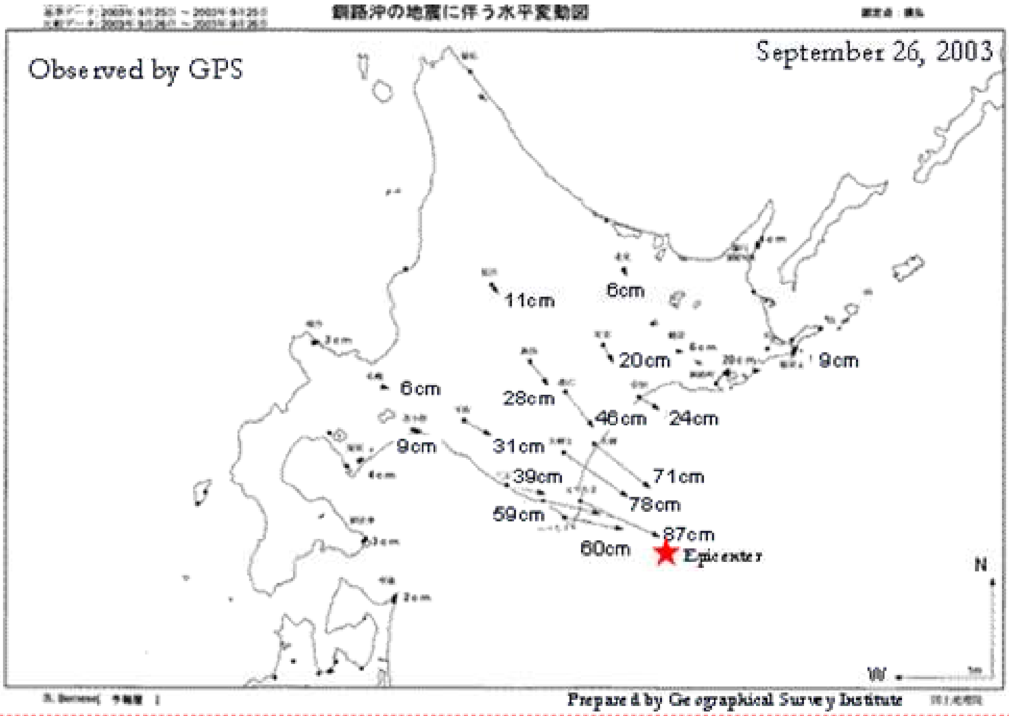


Figure A3.c - Horizontal displacement of crust.

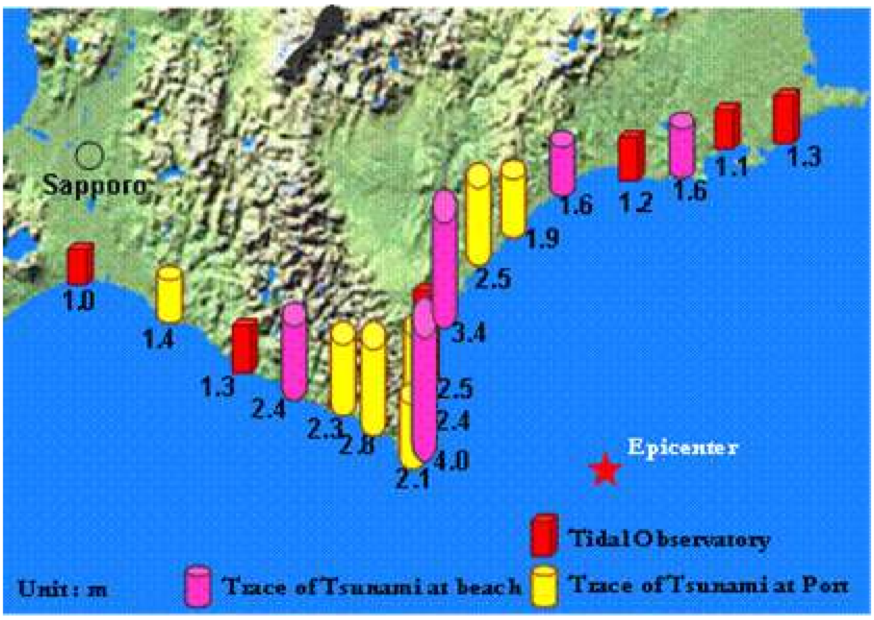


Figure A3.d - Distribution of tsunami height.

2. OUTLINE OF EARTHQUAKE DAMAGE

2.1 Physical damage

The summary of damage compiled by the Cabinet Office of Japan is shown in the following Table A3.a. Fortunately, the earthquake caused only a small number of victims, and a few residences were collapsed except some very old houses. One of the reasons is that the vulnerable buildings in the affected area have been already destroyed by several large earthquakes occurred in the past and aseismic buildings have been constructed instead. On the other hand, many infrastructures were damaged. Additionally, several automobiles were swept out to the sea and many turned out to be out of order due to being submerged, even though there was no human loss caused by the tsunami.

Table A3.a - Summary of the damage

Casualties			Damage to Residences		
Deaths	Disappearances	Injured	Complete Collapse	Half Collapse	Partly Damaged
0 (28)	2 (5)	844 (287)	60 (815)	81 (1,324)	1,292 (6,395)

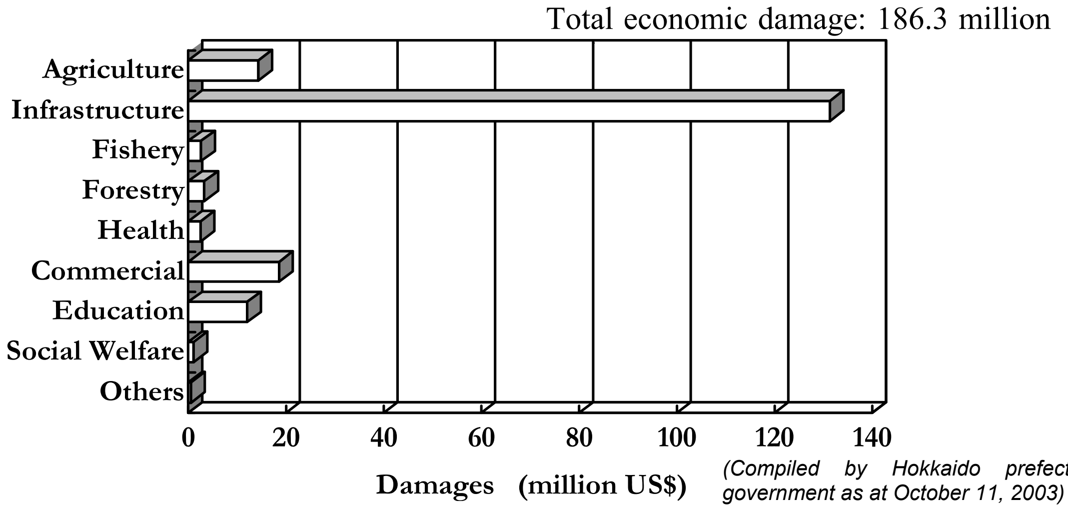
* Number in parentheses means damage of the 1952 Tokachi earthquake with M8.2.

Number of Damaged Roads		Number of Damaged Ports	Number of Incidence of Fire
Motorways	Ordinary Roads		
10	58	32	4 (of which 2 were oil storage fires)

(Compiled by Cabinet Office as at October 15, 2003.)

2.2 Economic damage

Economic loss, which is shown in Figure A2.e, was compiled by Hokkaido prefectural government. Total economic damage(direct) is estimated to be 186.3 million US$. The economic damage to infrastructure is significant. It makes up 70 % and over.



(Compiled by Hokkaido prefectural government as at October 11, 2003)

Figure A3.e - Economic loss.

3. FIELD SURVEY

Asian Disaster Reduction Center conducted a field survey in the affected area following the earthquake occurrence. Figure A3.f shows the survey route. In this figure, red line indicates a survey route. The team surveyed the coastline of Hokkaido fronted onto Pacific Ocean. Total distance of survey route was 550 km. Here, yellow box shows a typical damage in each survey point. Liquefaction phenomena were seen at the ports along the south-east coast. Road damage was occurred in this arched coast. Tsunami damage was observed at Tokachi port. Finally, the team visited the Tomakomai city and saw the second fire of oil storage.

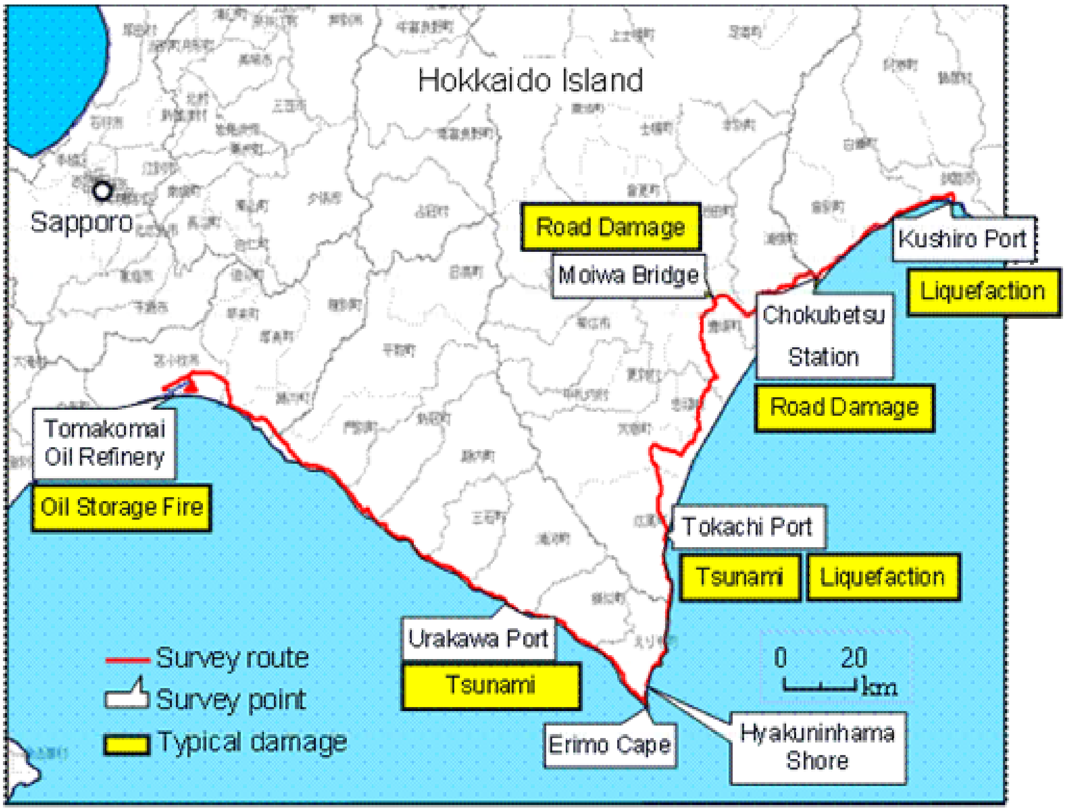


Figure A3.f – Survey route.

Photo A3.a shows damage to roads. These roads are damaged with the bank failure or caving due to liquefaction. Photo A3.b displays embankment damage in Tokachi River due to slope failure. Tsunami struck some fishing harbors. Photo A3.c shows stranded ships due to tsunami. These fishing boats are stranded on the land. Collapsed chimney of garbage disposal facilities is displayed in Photo A3.d. Damage to port facility is shown in Photo A3.e. The caisson of the quay was moved to sea side and grand level of backfilling was sunken 50cm.

(1) - Sand boiling

(2) – Caving due to liquefaction

(3) – Sinkage of backfilling for pipeline

Photo A3.d – Bank failure

Photo A3.a – Damage to roads.

Photo A3.b - Embankment damage due to slope failure (Tokachi river).

Photo A3.c - Stranded ships.

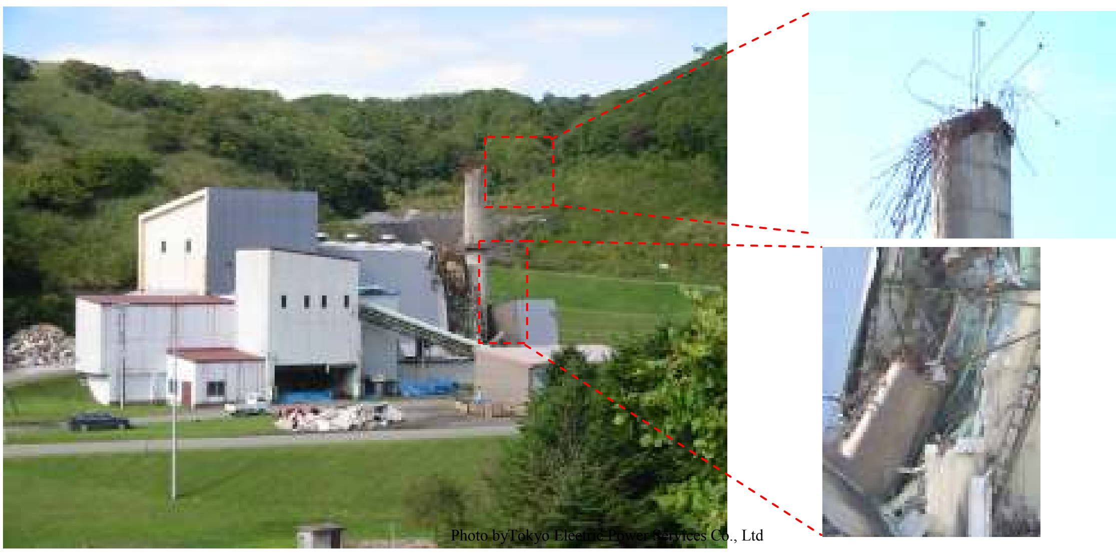


Photo A3.d - Collapsed chimney of garbage disposal facilities.

Photo A3.e - Damage to port facility.

4. OIL STORAGE FIRE

4.1 Damage to oil storage

Serious fire broke out at an oil refinery in Tomakomai City, which is about 200 km far from the epicenter. The JMA seismic intensity in the city was 5 lower and there seems to be no damage in the buildings and structures except oil storages.

At this oil refinery, oil storage fires occurred twice. One happened in the early morning of 26th directly affected by the earthquake and the second one occurred around 11 a.m. of 28th. The second fire was reported to be caused by the blown chemical extinguisher covering on top of leaked oil for emergency response. Photo A3.f shows a collapsed oil storage due to the second fire. Direct damage cost of the oil refinery is estimated to be about 90 million US$.

It is assumed that this fire at the oil refinery occurred due to the concurrence of conditions such as characteristics of seismic waves, ground condition of the tank yard and dynamic characteristics of the tank structure. Tomakomai is located in the largest basin in Hokkaido Island and influenced by the surface waves grown in the basin. In the recorded seismic waves, surface wave of dominant period 5-8 seconds was identified. Moreover, the natural period of damaged oil storage is calculated as about 7 seconds under the fuel level at the time. It seems that concurrence of the above two factors brought the sloshing. Then, it caused a slanting roof of tank and exposed the oil in the air on the floating roof. In the tank yard, 45 out of 105 tanks were affected by the earthquake in some way. In addition, it had been in a hazardous condition for a couple of days even after the fire was extinguished.

However, the origins of these fires have been under investigation and expected to be traced in detail.

Photo A3.f - Collapsed oil storage due to earthquake fire.

4.2 Social ferment

The oil storage fire caused some social ferment listed in Table 2. One is the environment damage. Bad oil smell, soot and scattering fire extinguisher foam were carried by the wind to the residential area. Second is the adverse effect on fire fighting. In this fire, fire fighting used enormous amount of fire extinguisher foam. Since Japan did not have enough stock, the government asked the assistance of US force in Japan and import from the eight countries immediately described in Table 2. Third is the economic impact. The Tomakomai port was closed for the fire fighting, it caused the obstacle to marine transport. Four ferry companies have claimed compensation for business interruption to the oil company.

Table A3.b - Social ferment due to oil storage fire.

Issue	Phenomenon	Response
Environment Damage	Bad oil smell	-
	Soot fall	
	Scattering fire extinguisher foam	
Adverse Effect on Fire Fighting	Lack of fire extinguisher foam	Assistance from U.S. forces in Japan
		Emergency import from U.K., U.S.A., Netherlands, Germany, Australia, Singapore, South Korea and China
Economic Impact	Obstacle to marine transport(e.g. ferry) due to closed port	Four ferry companies have claimed compensation for business (about 0.91 million US$)

5. CONCLUSIONS

The large earthquake occurred in the northern Japan, but the damage was comparatively small except infrastructure. Total economic loss was 186.3 million US$. Damage cost of infrastructure makes up 70 % and over of total loss. The most serious damage was the outbreak of oil storage fire and it is likely to stem from the surface wave grown in the basin.

These facts were made clear by the recorded data from high density seismometer networks which were established based on lessons learned from the 1995 Kobe earthquake. Also, GPS geophysical observation network has been established and utilized to clarify the tectonic activity. This information is available to the public shortly after earthquake occurrence on the Website.

Asian Disaster Reduction Center continues the investigation and learns the lessons from the 2003 Tokichi-oki earthquake disaster for the countermeasure against the future disaster.

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3) Geographical Survey Institute: http://www.gsi.go.jp (in Japanese)

4) National Research Institute for Earth Science and Disaster Prevention:

http://www.bosai.go.jp/index.html

5) Cabinet Office, Government of Japan: http://www.bousai.go.jp (in Japanese)

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A4 – Natechs in the United States: Experience, Safeguards, and Gaps

Laura J. STEINBERG
Department of Civil and Environmental Engineering,Tulane University
206 Blessey Hall, New Orleans, Loiusiana, USA
lauras@tulane.edu

Abstract

Natechs in the United States have been reported for many types of natural hazards, including earthquakes, hurricanes, and floods. There are a number of safeguards in place which serve to protect citizens and workers from the effects of natechs, although only the California Accidental Release Program is specifically aimed at preventing natechs (i.e. earthquakes). However, these safeguards are inadequate in a number of ways, including an emphasis on industry determination of the level of acceptable mitigation, older facilities which do not meet current design standards, lack of planning for simultaneous releases as might occur during a natural disaster-triggered release, and chemical release response plans which do not incorporate the need for operability in the aftermath of a natural disaster. Additional information is needed on the incidence of natechs - for example there needs to be a reporting mechanism by which releases triggered by natural disasters are tagged and compiled. In addition, a geographical risk-mapping showing where in the US natechs are most likely to occur is needed.

Keywords : natech, United States, GIS, risk mapping, earthquake, hurricane, flood,

1. INTRODUCTION

At present, the best source of data regarding the occurrence of natechs in United States is the study done by Showalter and Myers in 1994. In their study of the experience of emergency managers from 28 states with natechs from1980-1988, they documented 228 resulting from earthquakes, 28 from hurricanes, 16 from floods, 16 from lightning, 13 from high winds, and 7 from storms. They also showed that the number of natechs per year during the decade of the 1980's increased substantially over the time period.

In another study by Marsh and McLennan (1997), an insurance company, it was found that of the 100 most costly incidents of property damage losses in the hydrocarbon-chemical industry over the previous 30 years:

i) 8%of the incidents caused natech events.
ii) 13% of all losses occurred during startup and shutdown.
iii) accidents associated with vapor cloud explosions caused the most losses.

The second point is particularly salient to natechs, since startup and shutdown of sensitive processing units is one of the key ways in which the chemical industry prepares for extreme natural events such as hurricanes. Similarly, the third point is important because vapor cloud explosions are among the most lethal types of technological disasters that can occur, and they are triggered by releases of hazardous chemicals.

Some recent examples of natechs in the United States include:

- Hurricane Georges, 1998: Floating roof sinks, releases oil from storage tank in oil refinery. Also, tank with hazardous gasoline additives floats off its foundations.
- Hurricane Floyd, 1999: sets drums of hazardous chemicals afloat in Raritan River, New Jersey.

- Northridge Earthquake, 1994: 134 incidents of hazmat releases (including gas leaks) recorded; estimates state that 19% of industrial facilities probably experienced hazmat releases (Lindell and Perry 1997).
- Loma Prieta Earthquake, 1989: Numerous instances of hazardous chemicals from laboratories, hospitals, etc. found to have spilled.
- Lightening strike to Louisiana refinery in 2001 sets tank on fire and causes community evacuation.

2. SAFEGUARDS

In the United States, there are a number of ways in which industrial facilities and neighboring communities are safeguarded from natechs. These measures all help to reduce the risk and/or impacts of natechs to some extent, but do not eliminate them. Safeguards presently in place can be categorized as:

- Design criteria
- Chemical process safeguards
- Combined natural hazard and chemical process safeguards
- Community Land Use
- Disaster Mitigation and Response Planning

2.1 Design criteria

For earthquake resistance, many communities in the United States use the Uniform Building Code, which requires that structural design include provisions for seismic resistance of the 475 year earthquake. Others have chosen to follow the more stringent International Building Code, which requires seismic design for the 2475 year earthquake. For wind loadings, most communities refer to the ASCE guidance (ASCE 1997) which requires designs for the 50 year wind speed with an importance factor for structures containing hazmats which results in the equivalent of a 500 year wind speed for these structures. With respect to flooding, building in the 100 year flood plain is generally prohibited by communities, unless buildings are raised so that they are above the 100 year flood contour.

2.2 Chemical process safeguards

The United States Occupational Health and Safety Administration (OSHA) requires safety management and planning for chemical processing plants every five years. The primary objective of these plans is protect the health and safety of the plant workers. Two common methods for complying with these requirements are for industrial facilities to conduct hazard and operability studies (HAZOPs) and to perform fault tree analyses. In a HAZOP, a team of professionals familiar with the unit process under investigation is assembled – these may include process engineers, maintenance personnel, safety engineers, etc. – and the process is analyzed to discover how the process may deviate from normal operation, what might cause the deviation, what could prevent the deviation, and what the consequences of the deviation might be. Next, measures to prevent the deviation are proposed and implemented. In a fault tree analysis, a hazardous event such as a chemical release in a gas line is postulated and the set of events which could lead to this end result is determined. Then, measures to interrupt this chain of events are taken so that the hazardous event will be prohibited from occurring.

There are also two sets of requirements which apply to facilities with hazardous chemical processing facilities and are administered by the United States Environmental Protection Agency. Unlike OSHA requirements, these are meant to guard communities located near from industrial facilities from chemical hazards. Under the Risk Management Plan (RMP) provisions of the Clean Air Act, industrial facilities must prepare a safety management plan to minimize the risk of hazardous material releases affecting nearby ("fence-line") communities. As part of these provisions, companies must conduct an off-site consequence analysis in which a worst case of hazardous material release is postulated, and the resulting chemical plume is mapped and overlaid with a map of fence-line communities.

In addition to the RMP program, the EPA administers the Emergency Planning and Community Right to Know Act which requires states and local governments to create emergency response plans and planning groups for chemical accidents. Under this law, the EPA must also maintain a publicly-available listing of hazardous chemical releases (both intentional and accidental) from industrial and other sources. This listing is called the Toxics Release Inventory and is available at www.epa.gov/tri.

2.3 Combined natural hazard and chemical process safeguards

The California Accidental Release Program (CalARP) is similar to the RMP program of the Clean Air Act. It also requires off-site worst case analyses of potential chemical releases as well as planning for hazardous materials releases, but it also explicitly requires consideration of earthquake-caused hazmat releases. Special seismic guidelines provide specific recommendations on seismic design at chemical facilities.

2.4 Community land use planning

Communities have local land use jurisdiction and can restrict industrial facilities to industrial parks or require other types of separations between industrial facilities and residential areas. In this way, communities may be protected by long distances which the chemicals must travel before contacting the public.

2.5 Disaster mitigation and response planning

Each state has a State Emergency Management Agency which is linked to the national Federal Emergency Management Agency (FEMA) and supports county and local governments in the areas of civil defense, disaster mitigation and preparedness, planning, and response to and recovery from man-made or natural disasters. FEMA is now part of the Department of Homeland Security.

The Disaster Mitigation Act of 2000 requires community mitigation planning across all hazards in order for communities to receive government aid. According to the this Act "Mitigation Planning is a collaborative process whereby hazards affecting the community are identified, vulnerability to hazards assessed, and consensus reached on how to minimize or eliminate the effects of these hazards." In implementing this Act, communities have taken it to include technological hazards, and many have acknowledged the possibility of natural hazard-triggered technological disasters.

3. GAPS

Although there is some attention given to natech preparedness, mitigation, and response in the United States, there are still major gaps in these areas. These include:

i) Additional data. There is a need for centralized reporting of natechs. Currently, data is closely held by industry, and what is reported to the government is difficult for the public to access. In addition, there is little sharing of information regarding natech occurrences and risk reduction measures between countries.

ii) Probabilities of natechs occurring have not been calculated – this would complement similar data on other hazards. An assessment of the probability of natech occurrence, as a function of location and type of natural hazard, would stimulate and facilitate better natech planning. In response to this need, the author is beginning a two year study to provide probabilistic mapping of natechs in the US. (see http://www.tulane.edu/~civil/hazards/index.html)

iii) Vulnerability assessments to technological hazards have been left to industry to perform – it is difficult to verify the information provided and to determine if sufficient safeguards have been implemented. Furthermore, industry vulnerability assessments do not include natural hazard triggers and therefore preparedness, mitigation, and response plans do not consider special natech-related problems and obstacles. (see Steinberg and Cruz, 2003 for a discussion of the special problems encountered in responding to natechs in comparison to natural or technological disasters singularly).

iv) Older facilities do not meet current design standards. Design standards for seismic and wind loadings have steadily gotten more stringent in the last 40 years or so, but many facilities housing hazardous materials were built many years ago, and therefore do not meet current standards. In many cases, these facilities are not required to upgrade current standards.

v) Community mitigation and response plans do not incorporate simultaneous disasters. Similar to the planning and risk management by industry (#3 above), local communities are generally planning only for either a natural or technological disaster, but not for a natech. The ramifications of this type of single-hazard approach is discussed in Steinberg and Cruz, 2003.

vi) Design standards can be exceeded. Are they strict enough? Even current design standards, more stringent than in years past, can still be exceeded if a natural disaster is severe enough. Society must explicitly be asked to consider and decide upon the level of risk (and subsequent losses)with which it is comfortable.

4. IMPLICATIONS OF THE GAPS

From the foregoing, it is clear that a large earthquake, powerful hurricane, or properly sited tornado could trigger a catastrophic release of hazardous materials in the United States. Because we have generally not prepared for natechs, such a release would likely be extremely difficult to respond to effectively. The response problem might be quickly exacerbated by simultaneous releases from the common triggering natural disaster, and emergency response to the natural disaster might be quickly overwhelmed. In addition, because local planners and the public have not been adequately prepared for natechs, the public and community will not be able to respond appropriately and mitigation measures designed for "normal" operating conditions, such as those evaluated under OSHA requirements, would likely fail. Thus, the gaps discussed above would both permit a natech to occur as well as help incapacitate response efforts.

5. CONCLUSIONS

United States policy to protect property, workers, the public, and the environment from the effects of hazmat releases has not, for the most part, been linked to triggers by natural hazards. Thus, the vulnerability of industrial facilities and communities to hazmat releases is unnecessarily high, and response efforts are likely to be inadequate should a major release(s) occur consequent with a natural disaster.

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Section B: COUNTRY PAPERS

B1 – Information System for the Mitigation and Reduction of the Consequences of Accidental Events

Loretta FLORIDI
Department of Civil Protection, Presidency of the Council of Ministers,
Via Ulpiano 11, I – 00193, Rome, ITALY
industriale@protezionecivile.it

Abstract

With the goal of reducing the consequences of the overlapping of natural risk on industrial areas which lack structural mitigation as envisaged by the sector legislation in force, a communication model was designed to better prepare factory proprietors that find themselves in conditions of flood/seismic risk. According to an estimate by the MARS database, 4.1% of industrial accidents are caused by factors external to factories and to their production processes, such as floods and earthquakes.

The aim of this information system is therefore to raise awareness of the problems associated with the collapse of structures built for the storage or production of chemical compounds, or of the deterioration of those structures as a result of the stress owing to the impact of natural calamities and how those problems can be worsened when dangerous substances (toxic, explosive and flammable) are dispersed into the environment to contaminate the soil.

Keywords : industrial accidents, pollution, civil protection, Italy

1. INTRODUCTION

The physical environment we live in is continuously changing as a result of natural and man-made processes. The causes of some of these changes, such as earthquakes, floods, landslides and so on, are independent of human activities, while others are closely associated with them. Regulation of those activities by means of specific sector laws based on the general principles of quality of life and protection of human life and the environment seeks to impede environmental deterioration through systems of risk prediction and prevention and to guarantee security standards for the society by limiting and reducing the damaging consequences of accidental events.

2. POLLUTION RISK

The territory of Italy is characterised by extensive settlement and heavy concentrations of social and economic activities in areas highly earthquake-prone and rich in rivers, thus presenting the potential for contamination of underground water resources. The flatlands areas with the highest density of towns and industrial districts, and with the most productive water resources, are the most vulnerable to ground-water pollution. The underground strata in the majority of flatlands areas satisfy more than 80% of the society's water requirements.

Studies conducted in this regard demonstrate that the polluting substances are organic chlorine compounds and heavy metals resulting from industrial waste. The map of polluted areas, resulting from studies by the National Research Council (CNR), shows their widespread superimposition over areas with a high concentration of industrial plants.

In particular, it can be seen that the most extensive manifestation of this phenomenon coincides with Northern Italy where the terrain is essentially flat as compared with the rest of the country and where the highest industrial density can be seen. For example, the Table B1.a below shows the regional distribution of factories falling within the "Seveso II" category, i.e. that use and store dangerous substances. Table B1.b shows the distribution of factories falling within the "Seveso II" category according a larger geographical classification: *North*, *Centre* and *South and Islands*.

Table B1.a - Distribution of factories falling within the "Seveso II" category according to region.

Region	Art.8*	Art.6*	Region	Art.8	Art.6
Abruzzo	8	13	Marche	6	8
Aosta	2	2	Molise	4	1
Basilicata	2	4	Piemonte	38	79
Trento e Bolzano	5	6	Puglia	23	27
Calabria	6	6	Sardegna	25	23
Campania	27	46	Sicilia	33	36
Emilia Romagna	43	64	Toscana	21	39
Friuli	11	20	p.a. Trento	1	7
Lazio	32	45	Umbria	6	12
Liguria	17	18	Veneto	36	52
Lombardia	110	149	Totali	456	657
Total establishments 1.113					

*Art.6 OBLIGATION TO PRODUCE A NOTIFICATION

*Art.8 OBLIGATION TO PRODUCE A SAFETY REPORT

Table B1.b - Distribution of factories falling within the "Seveso II" category according to North, Centre and South and Islands.

	Art 8	Art 6	Total	%
NORTH	220	333	553	49.7
CENTRE	120	182	302	27.1
SOUTH and ISLANDS	116	142	258	23.2
Total	456	657	1.113	100

With a view toward regulating anthropogenic sources of risk and of reducing the damaging effects of natural calamities, specific sector legislation has been passed both for securing the area at risk of flood as well as for adapting public and private buildings to anti-seismic parameters in areas defined as seismogenic. Several important projects have been launched in the enforcement of the aforementioned legislation. However implementation of these interventions has not been homogeneous throughout the country and, as a result, not all at-risk areas have been properly considered. In some of these cases the local government, unable to comply with regulation provisions, has intervened with alternative, but strategically functional, initiatives for achieving the goal of reducing the risk and mitigating the consequences of an accidental event.

3. THE CASE OF THE AREA OF EMPOLI

Among the initiatives that have come to the attention of the Department of Civil Protection (as a result of its direct participation) it would appear significant to illustrate the most unusual one, which utilised this public information institute as an instrument aimed at reaching objectives by which to safeguard public health and the environment.

The case is that of Empoli, located in the region of Tuscany where, following a nation-wide testing of the civil protection plan for an overflow of the Arno River, concern was focused on possible accident scenarios involving the local industrial district of Terrafino. In the case of adverse weather conditions, the combination of high flood risk (the district is located in the Arno River basin) and the risk associated with the presence of some 200 small and medium-sized enterprises (whose production typology involves the use and storage of dangerous substances), resulted in a scenario in which natural flooding was superimposed over the risk of industrial accidents, with the consequent potential for ground pollution with toxic substances being released even at a noteworthy distance from their point of departure.

The goal of the city government in the case of flooding in the industrial area was to keep water from reaching the places where dangerous substances were stored and thereby avert damage ulterior to that specific to the impact of the flood itself.

It was therefore decided to launch an informational campaign aimed at the proprietors of the various Terrafino factories in order to raise their awareness of the potential risks represented by the fact that that industrial district, on the basis of the parameters dictated by the legislation in force, falls within a higher flood risk category, and that a calamity would thus be able to trigger a series of accidents leading to environmental pollution.

4. THE INFORMATIVE BROCHURE

A work group was set up to study the problem from various points of view. In addition to the representative for the Department of Civil Protection, the group also included representatives of local bodies involved in dealing with the problem. The project was to design an informative brochure to be distributed to factory proprietors.

A semi-structured communication model was chosen to supply a series of data on risk conditions, demonstrating the dangers of superimposition and listing suggestions and recommendations for what action to take in order to adequately handle a flood emergency.

With the aim of generating a truly communicative process that, by means of the interaction between the receiver and the sender of the message, one of the goals of the project would be able to modify risk perception through the adoption of new and more adequate behaviours. A brief questionnaire was designed posing a limited number of open questions in order to verify how favourably the informational campaign had been received and what further action might be taken to deal with the problem.

This technical brochure's text is information-oriented, its cover showing a topographical map of the area involved. A brief Foreword explains that the MARS database indicates among the events that cause industrial accidents that approximately 5% of them are attributable to factors external to the production process and the factory itself, and that among these factors are floods and earthquakes. The brochure goes on to describe the accident scenarios.

4.1 Accident scenarios

The following accident scenarios could be triggered during a flood event:

- dispersion and transport by air (toxic cloud), water and ground of even minimal quantities of toxic/harmful substances dangerous for humans and the environment;
- violent reactions because of the contact between water and chemical compounds that generate toxic gases;
- fires and explosions.

The consequences of the damaging effects triggered by these scenarios are illustrated in Figure B1.a below.

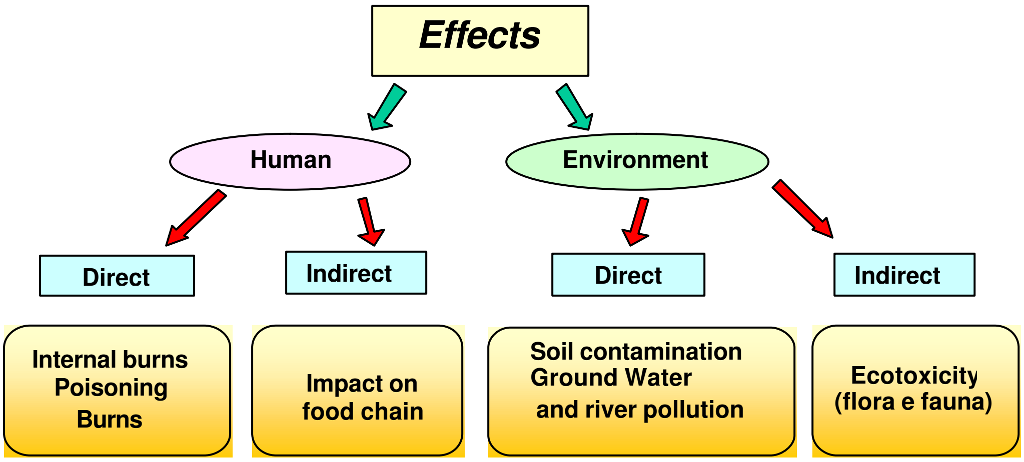


Figure B1.a - Consequences of damaging effects triggered by accident scenarios.

In order to avoid accidents it is suggested that a series of precautions be adopted in the presence of a flood emergency:

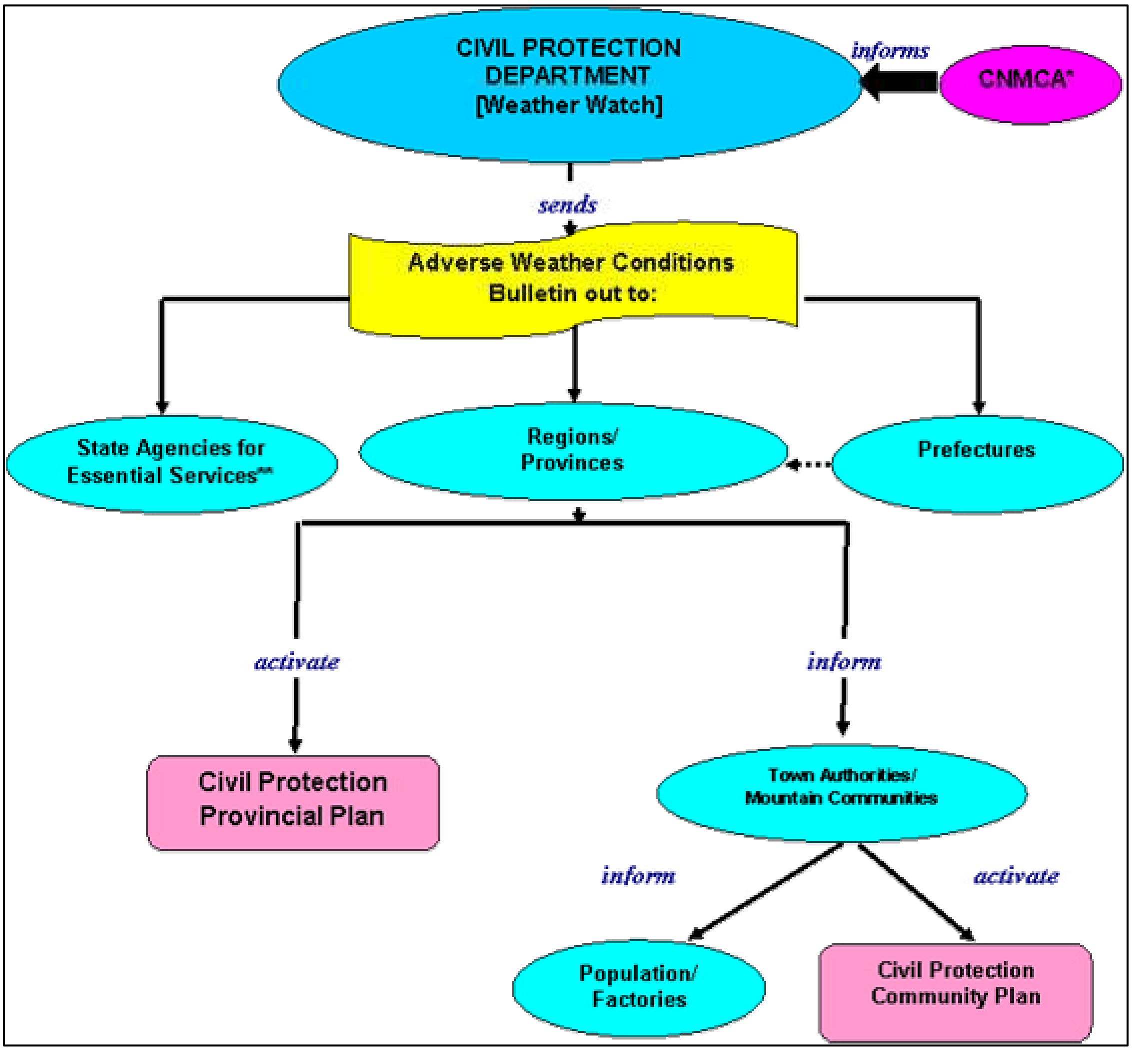
- *Protective measures leading to temporary interventions in the case of imminent danger:*

- interruption of the production process;
- anchorage of structures most exposed or least resistant with steel cables or the like;
- verification of storage tanks seals;
- securing of all dangerous materials and substance storage systems located in risk areas.

- *Preventive measures involving fixed interventions such as:*

- strategic placement of substances inside the plant in order to avoid chemical incompatibility;
- boosting the resistance of structures by means of an accurate choice of materials and design solutions;
- placement of pressurised and cryogenic storage systems above the maximum height reachable by water;
- creation of a drainage system;
- construction of trapezoid-section walls to protect the points most at risk.

The securing of plants and substances is closely linked with the timeframe within which the competent local authorities are able to disseminate flood alerts. At the present moment adverse weather advisories are disseminated according to the system illustrated in Figure B1.b and which are being revised to include the introduction of functional regional centres that receive, assess and disseminate advisories in real time.



** National Airforce Meteorology and Climatology Centre*
***Polstrada, Autostrade SpA, ANAS, Telecom, FFSS, Servizio Nazionale Dighe, ENEL*

Figure B1.b – Scheme Flow-chart for the communication of adverse weather conditions bulletin.

The timeframe within which adverse weather advisories should be disseminated at the local level, are also indicated:

Attention: announces the possibility of calamitous events and alerts those responsible for emergency intervention.

Pre-alert: allows for the initiation of procedures for securing the most dangerous substances.

Alert: completes the operations by which to effectively handle the event for which specific emergency procedures follow in the case of adverse weather conditions.

Actions to be carried out by the factory in each of the above phases are listed below:

Attention: activation of emergency procedures to be carried out by the factory without having to interrupt the production process:

- Wearing of protective clothing necessary when transporting substances;
- Preparation of means for transporting the substances to safe storage and loading start-up;
- Wrapping of substances in watertight packing and precise labelling of contents;
- Giving transport priority to the most dangerous substances (those that react violently to water and air exposure);
- Raising of all containers above the maximum height reachable by water;
- Hermetic sealing of silos and underground storage tanks.

Pre-alert: intensification of emergency procedures within the factory:

- Interruption of utility systems (water, steam, compressed gases);
- Interruption of the flow of fuel to electrical plants;
- Interception of substances flowing inside pipes;
- Shutting down of electrical and heating systems;
- Interruption of the operative production phase;
- Removal of all materials and equipment on the production floor so as to reduce the risk of impact;
- Evacuation of personnel not essential to emergency operations.

Alert: the following operations are carried out:

- Arrival of special teams of experts in the reduction and mitigation of the consequences owing to toxic substances being released in to the environment.

5. CONCLUSIONS

The informative model has been evaluated by local industrial associations, who approved this type of public intervention as a result of the important ideas supplied for the safety of factories and their products in the case of overlapping of natural and industrial risk.

It is not possible to supply the results of the initiative as distribution of the brochure has not yet been completed, but it is interesting to point out that one of the Terrafino factories (below the level of the river) has already had an exterior steel structure built for the purpose of raising dangerous substance containers off the ground where they had been piled up for years outside the factory.

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B2 – Natech disaster risk management on the territory of Bulgaria

Dimitar DONKOV
State Agency for Civil Protection
30 N. Gabrovski Str., Sofia, BULGARIA
it@cp.government.bg

Abstract

Undisputed and logical is the fact that the analysis of regional threats in the territory of the country serves as a basis for NATECH DISASTER RISK MANAGEMENT. The main threats on the territory of Bulgaria are described below.

Keywords : industrial accidents, pollution, civil protection, Italy

1. MAIN THREATS WHICH MAY CAUSE A DISASTER, TRIGGERING A NATECH EVENT AND WHICH ARE OF GREATEST IMPORTANCE FOR NATECH DISASTER RISK MANAGEMENT IN THE TERRITORY OF THE COUNTRY

1.1. Seismic threat

Seismic threat is a threat of highest priority on the territory of the country. The territory of the Republic of Bulgaria is influenced by both internal and external seismic hazards. The maximum expected earthquake is of magnitude 8 on the Richter scale.

According to the 12- ft degree MSK scale territorial seismic division of the Republic of Bulgaria, it is clear that in practice the whole territory of the country should be ensured against earthquake's effects. That is illustrated in the map of seismic regions in Bulgaria, which was created in 1987 (Figure B2.a).

The seismic regions map is an integral part of the "STANDARDS FOR DESIGNING NEW BUILDINGS AND FACILITIES IN EARTHQUAKE REGIONS" dated 1987. These standards are in force at the moment. The map strictly defines the seismic regions where occurrence of earthquakes of different destructive power is possible. And here is the paradox. On the one hand, it is clear that according to the standards in practice the whole territory of the country must be secured against seismic impacts. On the other hand, the earthquakes on the territory of the Republic of Bulgaria are rare events compared to, for example, Japan. This fact does not stimulate the country to prepare for overcoming earthquakes. In fact there is an opposite effect. This is one of the main problems of the Civil Protection Authorities in carrying out preventive activities against natural hazards. A rule the further in the past is an earthquake, the lower the preparedness for overcoming a new earthquake. The recollections and the lessons learned from the earthquakes in the period 1901 to 1928 have almost completely faded away. For this reason, seismic threat is placed on the first placed as a threat of highest priority for the country.

1.2. Threat of floods

Floods occur in the Republic of Bulgaria as a result of the quickly thawing snows and the heavy rains during the winter and spring. In spring considerable floods may occur along the Danube River as a result of the intensive snow thaw in the middle European mountains. Ice-breaks may occur causing disasters in the river valley. The regions along the river beds which are subject to flooding are shown on the map of flooding zones on the territory of the country in Figure B2.b.

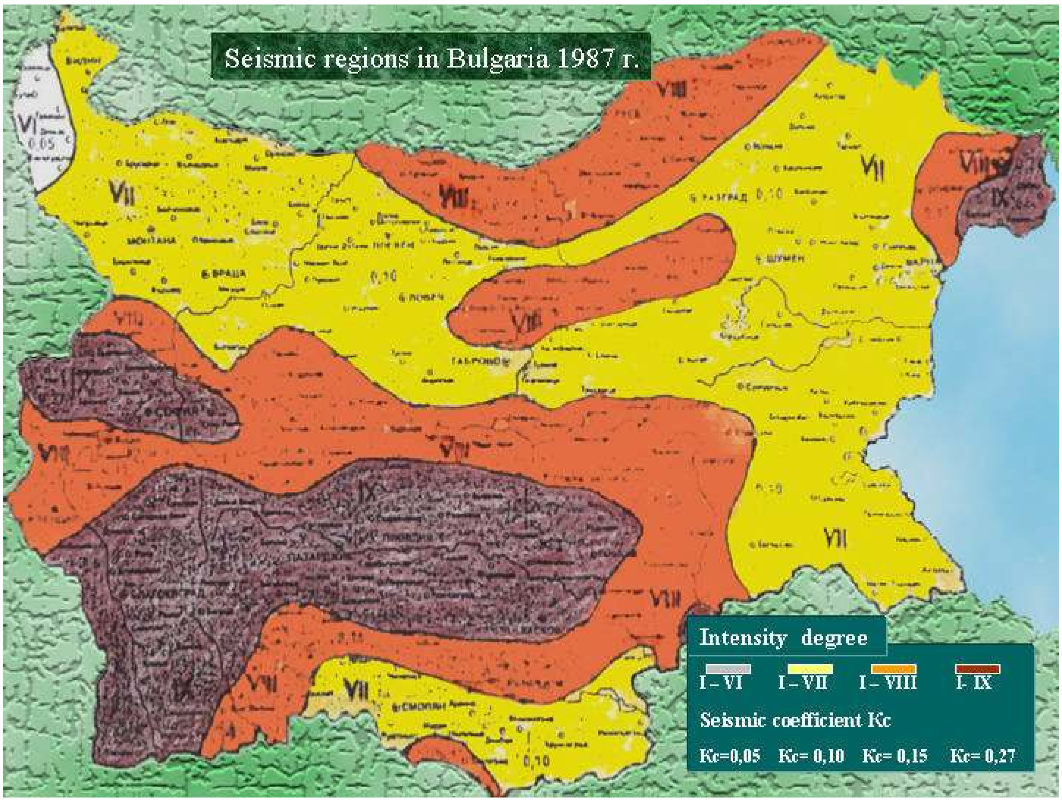

Figure B2.a - Map of seismic regions in Bulgaria, 1987.

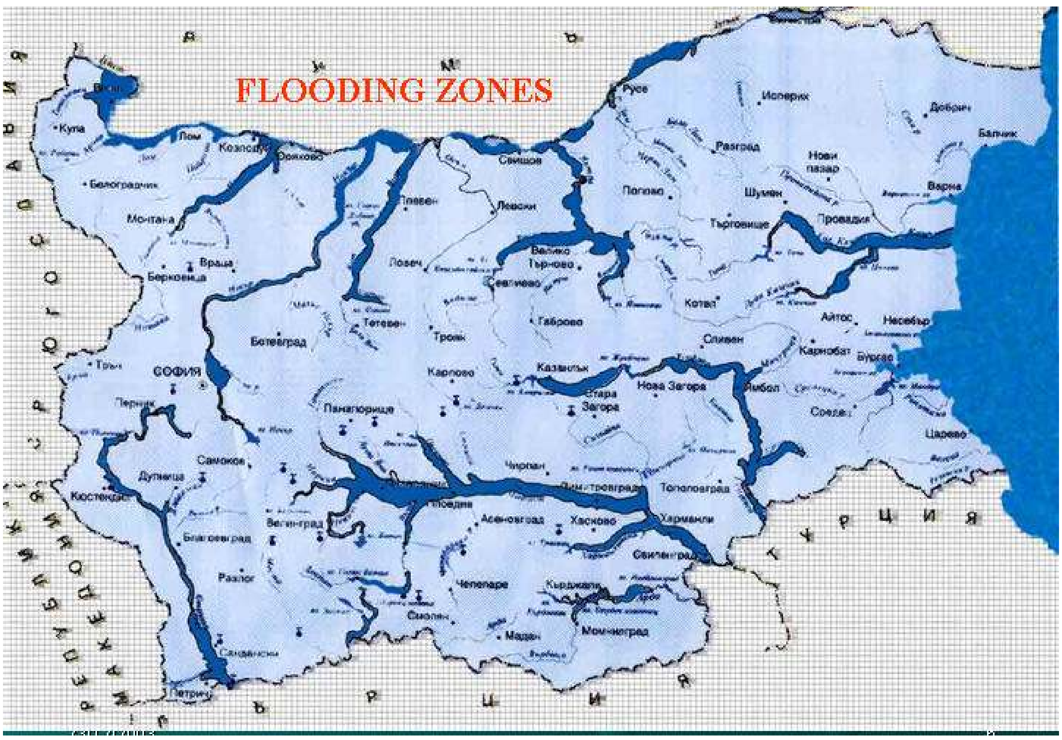

Figure B2.b - Map of flooding zones in Bulgaria.

The long lasting heavy rains in the mountainous part of the country cause floods in the upper and lower streams of the rivers. The life of the population and the national economy are endangered by big dams in the country. The danger concern settlements, important communications and agricultural lands located in flood prone areas.

1.3. Threat of landslides

A great number of disasters caused by landslides occur on the territory of the country.

Hundreds of landslides and abrasive regions are registered and a greater part of them are active. The movement of land layers and the landslides are an enormous threat to a number of settlements basically along the Black Sea coast and the Danube river valley.

There are 960 landslide areas catalogued within the territory of the Republic of Bulgaria, where 350 of them are situated in built – up areas and health resorts, and they are spread over a territory of 20,000 ha (Figure B2.c).

The landslides usually occur when the land layers are heavily moistened or as a result of earthquakes. So, periodically after years of plenty of rains they cause serious damage to the buildings and infrastructure in some densely populated regions.

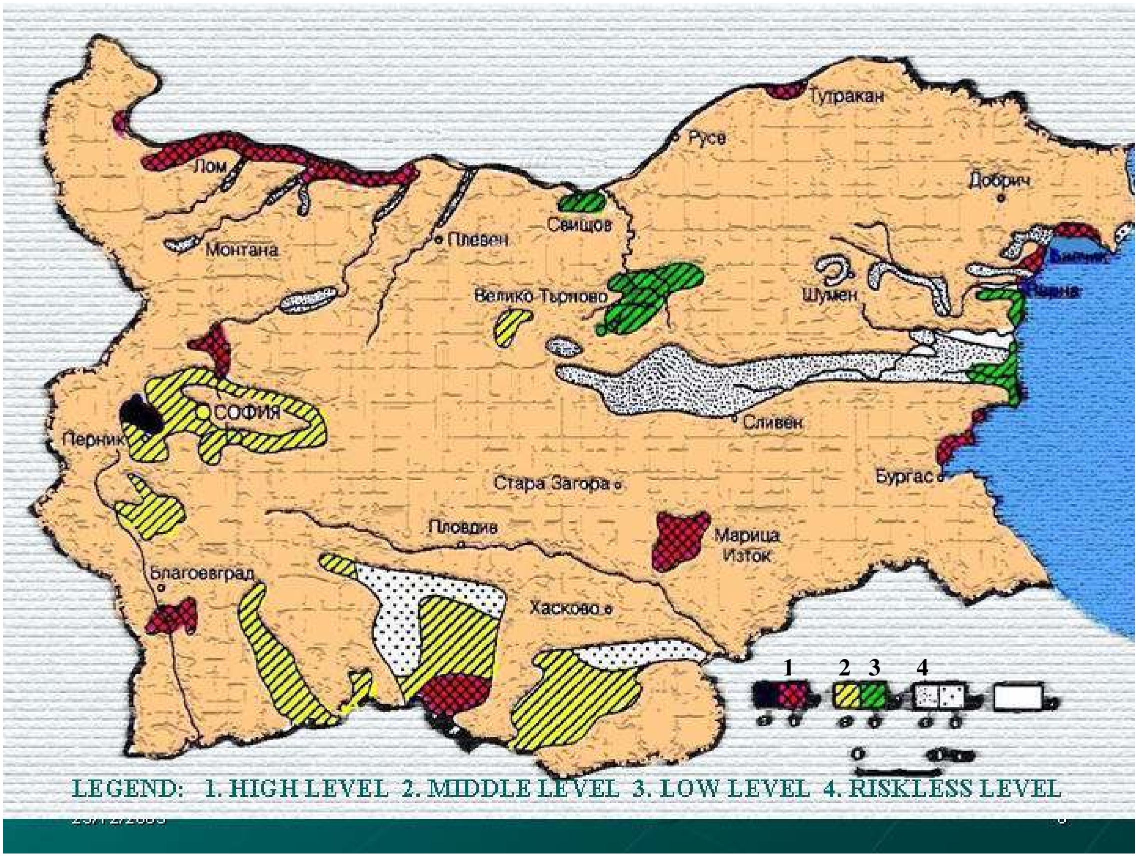

Figure B2.c - Landslide zones, based on their frequency of occurrence, in Bulgaria.

1.4 Other threats which on rare occasions could trigger a natech event

1.4.1. Strong winds

Strong winds are known as wind spouts in the territory of the country. They may disturb electricity and communication networks.

1.4.2. Heavy snowfalls, snow storms and ice-bounding.

Sharp temperature changes in winter lead to heavy snowfalls, accompanied with strong winds. Snowdrifts on the mountain automobile roads and railways are formed. Transmission lines and open-air communication facilities are iced over.

Yearly about 50% - 60% of the country is endangered by snowdrifts.

The population supply of food, medical care, etc. is strongly disrupted.

2. NATECH RISK ASSESSMENT

In each branch of the national economy, there are methodologies and instructions for technological risk assessment. However, they concern only risk assessment of the production processes in each particular case. They do not take into account the natural hazard-triggering factor. Using these methodologies and the experience gained as a result of different accidents involving dangerous processes a risk assessment is carried out. Where there is the potential of an event occurring as a result of a natural hazard, an individual natech risk assessment is done.

Distribution of the technological risk and the natech risk in the territory of the country is presented in Figure B2.d. For each site, the natech risk assessment depends on:

i) Site Location,
ii) Prognosis of natural disaster occurrence according to their expectation,
iii) Scenarios of the potentially triggered technological disasters.

2.1 Site location

Each location has its particular datum corresponding to the facts concerning seismic activity, floods and landslides. Information for the territory of the country is used at the national level. However, some sites require additional information such as:

- Micro seismic divisions of the district,
- Hydrological aspects,
- Geological aspects,
- Investigation of the general seismic stability of the buildings, facilities and technological equipment, taking into account additional factors resulting from the production processes as follows:
    - wear of the different kinds of elements;
    - corrosion;
    - construction changes of the structures;
    - substitution of construction elements;
    - prohibitive or sustained overload;

- considerable damage to structures, and type and level of the effects on building stability, or on the stability of equipments.

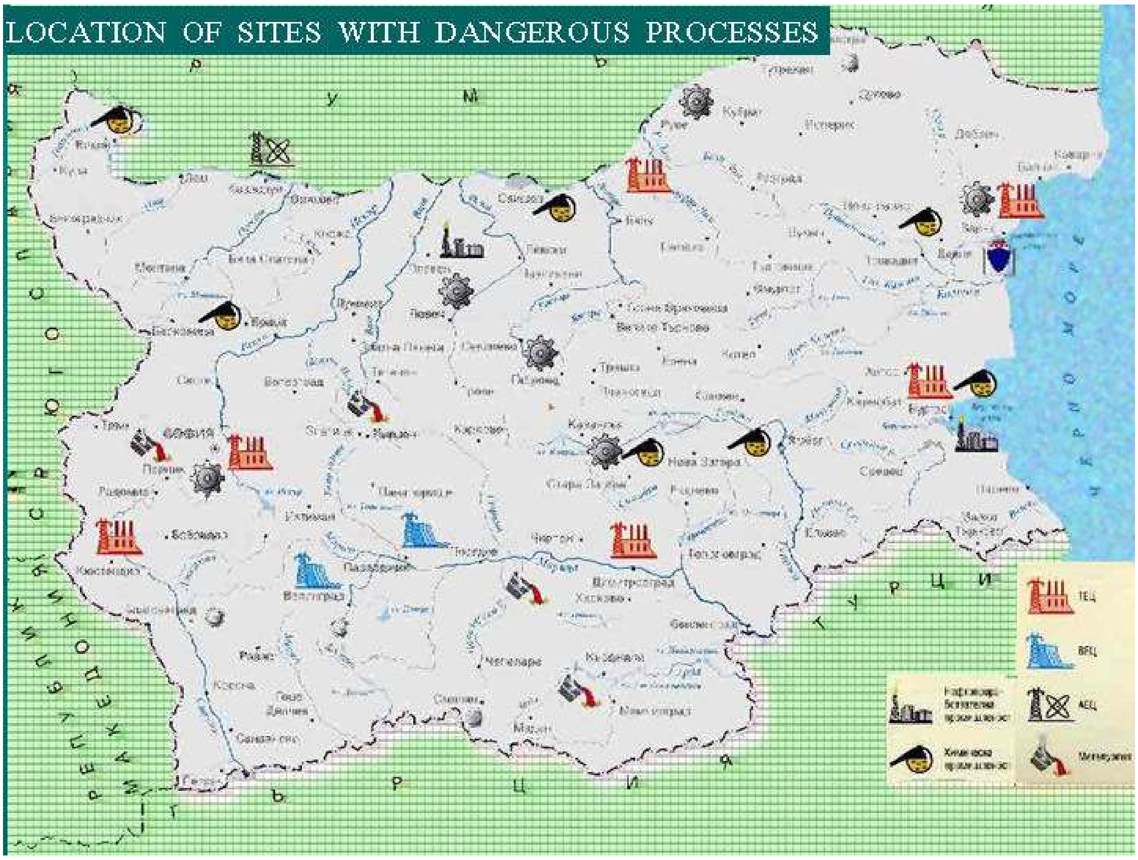

Figure B2.d - Distribution of e technological and natech risk in Bulgaria.

2.2 Prognosis of natural disaster occurrence according to their expectation

The prognosis for each site subject to investigation should be done individually. The prognosis depends on the level of importance of the site to the national economy and the level of risk to the population as a result of potential “domino effects” triggered by the natural hazard. For example, in case of seismic assessment of the structures at a particular site different criteria can be used:

- When this site is of “special importance” the assessment is done based on a 5000 year- recurrence interval.
- When the site is “very important” this period may be of 1000 years.
- When it is “just an important” site this period may be of 475 years.

2.3 Scenarios of the potentially triggered technological disasters

It is very important to know how a technological disaster can result from a natural hazard. This is of exceptional importance to effectively carry out emergency response actions and to prevent “domino effects”. For each particular technological process the scenarios are identified based on the examination of accumulated experience from past accidents. The natech risk assessment in Bulgaria is only done for some bigger sites with dangerous processes which could result in adverse health effects on people, and damage to property and the environment. The sites for which a risk assessment has been done are:

- ***The nuclear electric power plant at the town of Kozlodui.*** The risk assessment is done for the whole site and in particular for each of the production blocks. The site follows strict regulations for observation and risk assessment. Technological safety and protection systems against natural disasters are under permanent control by internal authorities (e.g., "State agency for control on the electric power consumption", "Committee for using nuclear power for peacefully purposes", "State agency for civil protection") and other international organizations which are concerned with nuclear plant safety.
- ***Hydro technical facilities***:
  - *Dams*: 215 items;
  - *Embankments along the Danube River*: 295 km (10%);
  - *Setting basins for cinder and slag deposits*: 72 items.
- ***Plants and enterprises with technological installations and equipments operating with dangerous chemicals and other products***. They are about 20 facilities and they are shown in Figure B2.d
- ***Transmission lines of the integrated electric power supply system***. High voltage power transmission lines as it follows (e.g., 750 voltage – 85 km, 400 voltage – 1852 km). (please see Figure B2.e)

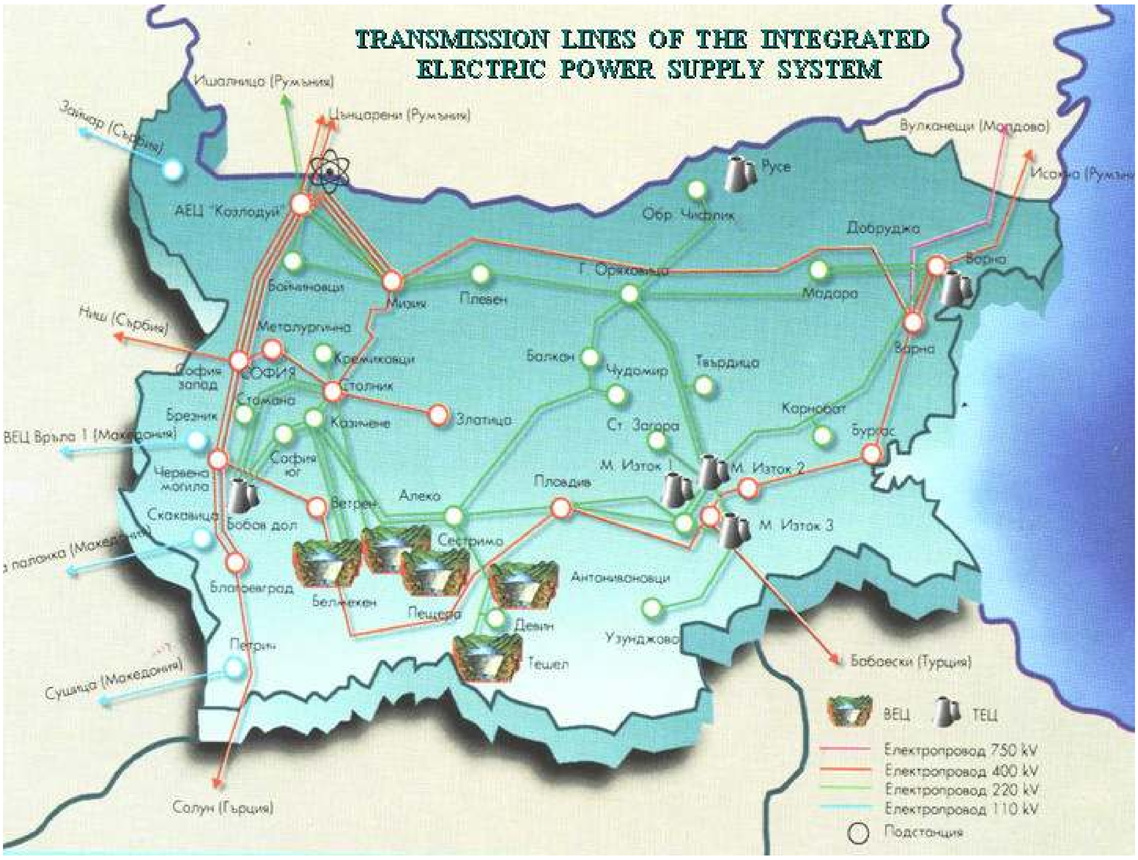

Figure B2.e - Transmission lines of the integrated electric power supply system in Bulgaria.

- ***Storage Facilities and Fertilizer Plants***. A natech risk assessment for these sites is inadequately done. There is no complete information about the location of these sites, nor the names and quantities of chemicals stored in them.

3. PREVENTION AND MITIGATION MEASURES

In Bulgaria there are legislative standards for Civil Protection, which are obligatory and which can provide a steady functioning of the national economy during crisis situations including an armed conflict (a state of war).

A special part of the standards are the "Engineering and technical norms for Civil Protection". These norms have several sections including:

i) General principles,
ii) Norms for setting –up settlements, plants and facilities,
iii) Settlement planning (urban planning),
iv) Buildings and facilities,
v) Facilities for civil protection,
vi) Water supply systems and hydro technical equipment,
vii) Electricity supply,
viii) Oil and gas pipelines,
ix) Railway system and roads,
x) Transmission and radio transmit relay system,
xi) Forming and making up documentations of designs and their co-ordination with the Civil Protection authorities.

During a long period of time the territory planning obeyed the "Engineering and technical norms for Civil Protection". Planning and settlements setting up are obeyed nowadays too. Just by means of strictly enforcing these norms, prevention and mitigation measures are done in practice. However, in terms of protection against seismic risk, even the "Engineering and technical norms for Civil Protection" can not guarantee against damaging earthquakes in the country. Therefore, protection against earthquake-triggered technological disasters is very complicated.

4. THE PROBLEM REFERRING TO SEISMIC SECURING OF BUILDINGS IN BULGARIA

As it is well known the main purpose of seismic engineering activities is lowering of seismic risk through:

- minimization of human casualties,
- preservation of material and cultural values,
- securing the functioning of life-supporting activities.

According to the "Standards for designing of new buildings and facilities in earthquake regions" dated 1987, the main formula for seismic forces determination is:

$$E_{ik}=C.R.K_c.\beta_i.?_{ik}.Q_k$$

In this formula the *coefficient of seismicity* – K_C – is a basic parameter, on which the value of rated seismic forces depends. In Bulgaria a problem arises as a consequence of having used different values of this basic parameter in the past years, depending on the regional seismic divisions in each particular period of time.

4.1 Seismic bearing force and stability of buildings and facilities in Bulgaria constructed before 1987

What is the reason for considering buildings and facilities built before 1987? The reason for discussing seismic stability of buildings constructed before 1987 is something special. It is related to the comparison of the real seismic bearing force and stability of buildings and facilities constructed before 1987 with the expected seismic forces corresponding to the Seismic Regional Division Map updated in 1987. A question must be asked, are those buildings and facilities capable of bearing the expected seismic loads?

To give just an idea of the problem in Bulgaria, a brief review and analysis of statutory regulations on seismic construction in before and after 1987 is presented.

4.2 Groups of buildings

4.2.1 *I Group* of buildings constructed until 1957

Until 1950 there isn't any statutory regulation on seismic construction in Bulgaria. Buildings and facilities constructed till the beginning of 1958 are not secured per statutory regulations against earthquake impacts. In 1957, after the model of the Soviet "Standards and rules for construction in seismic regions" (CH-8-57/M-1957), a try is made for introduction of a certain order on the problems of seismic construction in Bulgaria. In 1957 in Bulgaria a "Regulation on designing and execution of buildings and facilities in earthquake regions of the People's Republic of Bulgaria" is accepted. This document is the first official attempt at fixing of seismic degrees of seismic centres in Bulgaria, and localization of regions around them.

4.2.2 *II Group* of buildings constructed from 1957 to 1964

In the period from 1957 to 1964 seismic impact has been accounted very roughly, as a static horizontal loading. Buildings are not studied as a dynamic model. As a result of re-evaluation done for the territory of the country, on 13.11.1964 a "Regulation on construction in earthquake regions" was accepted, as well as the first Seismic Regional Division Map of our country.

4.2.3 *III Group* of buildings constructed from 1964 to 1977

In this period the areas of the VII, VIII and IX degree intensity have been considered as destructive. There was a requirement for obligatory provision of seismic safety of buildings and facilities at such zones. These zones have comprised only about 14% of the territory of Bulgaria. For about 86% of the territory practically no seismic provision has been required.

So in this period, only on 14% of the state territory, buildings are already treated as a dynamic model, and set of structural requirements on their seismic safety have been practically applied. In 1977 the earthquake of seismic centre Vrancha (Romania) shook the towns of Nikopol, Svishtov, Rousse, Tutrakan, Silistra and Dulovo, of power greater than the expected one according to the then applicable seismic map. In response to this, the existing regional division map was changed and the destructive zones increased from 14% up to 39%. (Figure B2.f)

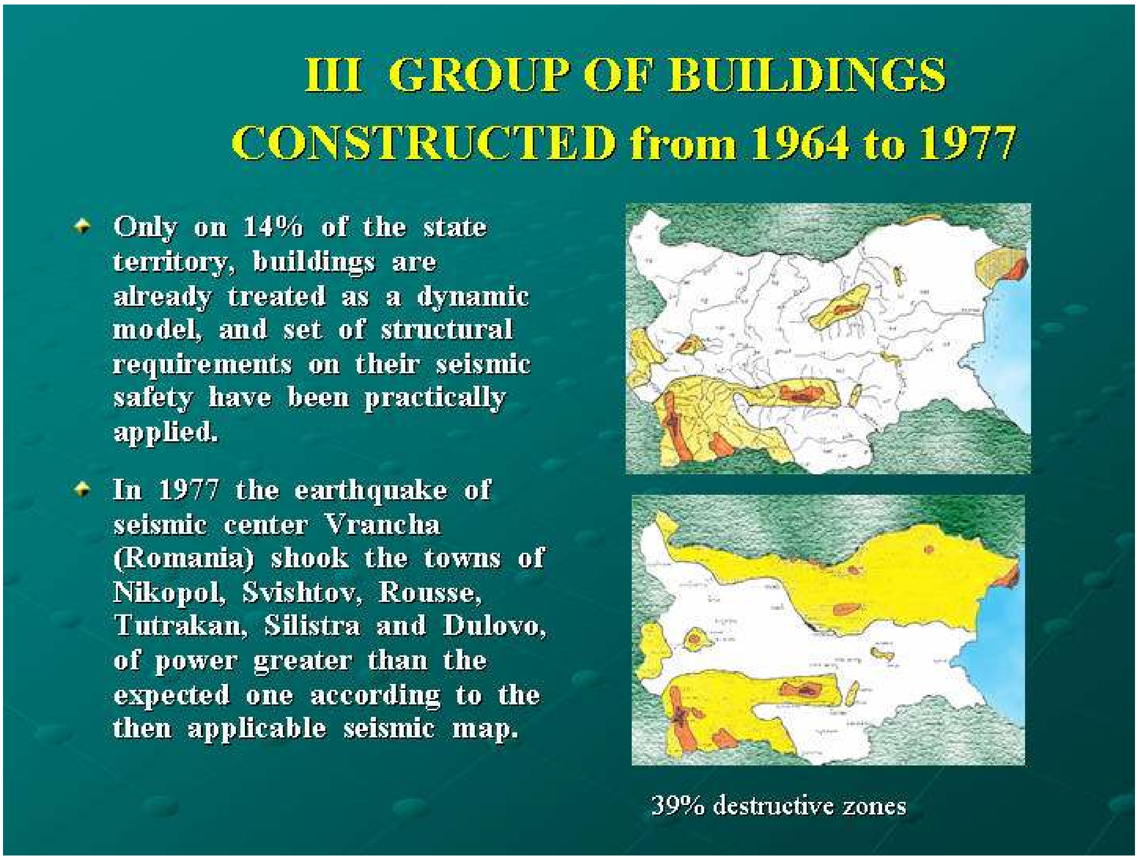

Figure B2.f – Update of the seismic regions in Bulgaria:
destructive zones increased from 14% (map above) up to 39% (map below).

4.2.4 *IV Group* of buildings constructed from 1977 to 1987

During this period the "Regulation on provision of seismic safety", dated 1964 remained in force, with some substantial amendments. Exceptionally important and valuable for the provision of seismic safety of buildings and facilities were the obligatory requirements for the different seismic regions about the bearing elements of buildings:

- set minimum percents of reinforcement,
- additional requirements towards to the strength properties of materials,
- restrictions on openings in surrounding elements and floor constructions,
- continuity of strip foundations, and other structural elements, etc.

In 1986 after the earthquakes in Strazhitsa, Popovo, Velingrad, etc., the Geo-Physical Institute at the Bulgarian Academy of Science, once again amended the seismic regional divisions map of Bulgaria by developing of a new Seismic Regional Division Map. According to this map, destructive zones now comprise more than 98% of the country's territory. (Figure B2.g)

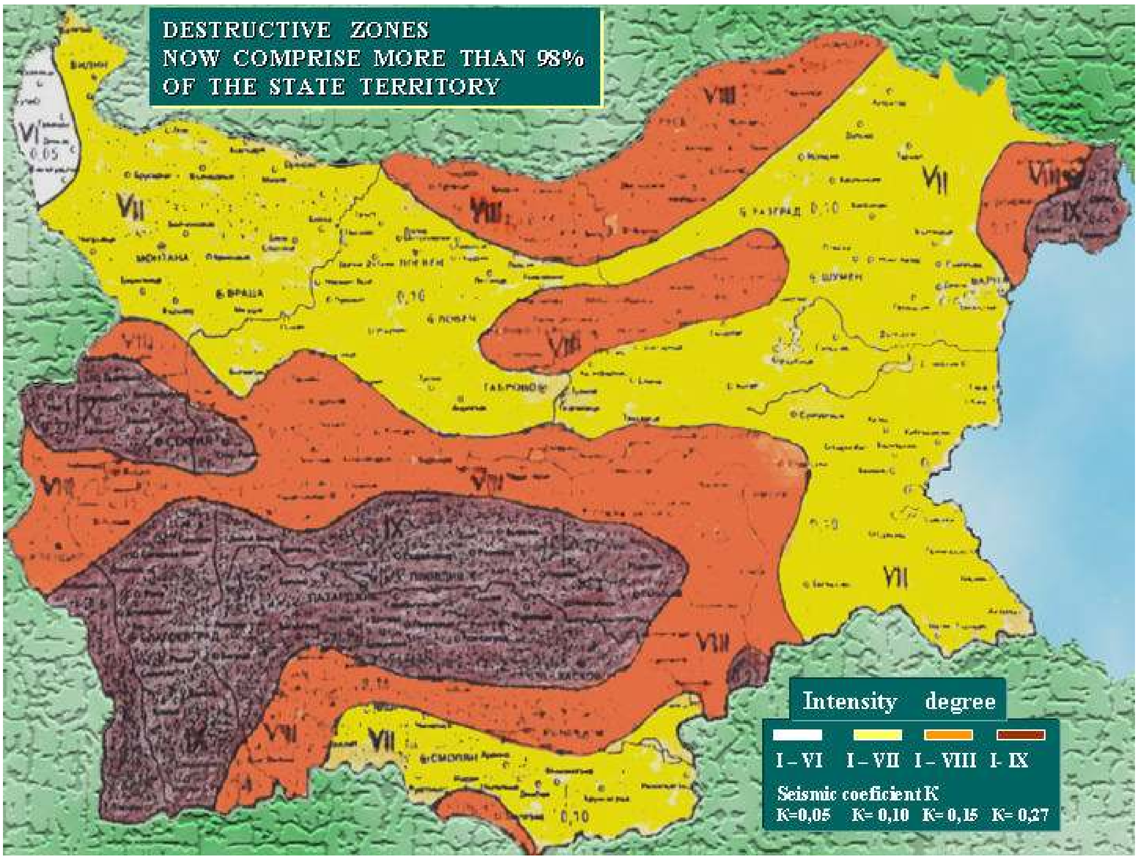

Figure B2.g – Update of the Seismic Regional Division Map in Bulgaria.

<u>Conclusions</u>

- The destructive zones of 14% in 1964 now cover almost the whole of Bulgaria.
- Buildings are already threatened everywhere by destructive earthquakes, and provision of their seismic safety is obligatory.
- The individual zones of the VII, VIII and IX degree seismic intensity have also changed their scope.

For example the destructive seismic zone with IXth degree intensity has changed its scope from 0.08% up to 20%.

These changes of the scope of the threatened territories can be seen in Table B2.a.

Table B2.a - Area of zones in % of the territory of Bulgaria, according to the Bulgarian seismic maps, which changed after significant earthquakes struck the territory.

No.	Regions of seismic intensity per degrees	Character of damages upon the seismic degrees	Area of zones in % of the territory of Bulgaria, according to the seismic maps dated the year of:		
			1964	1977	1987
1	V? degree	Light damages	85.50	60.45	0.70
2	V?? degree	Destructions	14.00	38.83	48.30
3	V??? degree		0.12	0.54	31.00
4	?? degree		0.08	0.18	20.00

4.2.5 *V Group* of buildings constructed in the period from 1987, until nowadays

The buildings from the Vth group *theoretically* are not seismically threatened.

Conclusions

- Until 1987 many buildings and facilities were constructed in seismically threatened regions of our country. Now, these happen to be in destructive seismic regions of the VII, VIII and IX degree intensity.
- They will be now subjected to seismic forces considerably higher than those, for which the buildings are secured.

That is a way of comparing the standard requirements dated 1964 and 1977 with those dated 1987, and the methodologies for defining of seismic forces on structures is applied to define the increase of seismic forces over seismically unsecured buildings and facilities. The change of seismic forces as a result of changing in the degree of seismic intensity is shown in Table B2.b.

Table B2.b – Increase in seismic forces as a result of changes in the degree of seismic intensity.

No.	*Change in the degree of seismic intensity upon alteration of seismic maps within the period 1964 – 1987 included*	*Increase of seismic forces in times*
1	From V? to V?? degree	2,22 -:- 3,36 times
2	From V? to V??? degree	3,40 -:- 5,04 times
3	From V? to ?? degree	6,10 -:- 9,07 times
4	From V?? to V??I degree	1,68 -:- 2,40 times
5	From V?? to ?? degree	3,20 -:- 4,20 times
6	From V??? to ?? degree	1,51 -:- 2,16 times

As it can be observed, these changes of the rates of seismic forces are considerable.

Other conclusions are:

- To expect that a building constructed before 1987, which is not seismically secured, may stand a seismic shock of the VIII-th or IX-th degree intensity (upon five, or nine times higher loads, respectively) is just simplicity.
- Investigations on this problem have proven, that the share of buildings executed before 1987, which would be able to stand the real seismic impacts, is very small.
- Rates of the active seismic forces upon buildings have increased about 1,8 times for Sofia as an example.
- For the seismically unsecured buildings for about 8% of settlements in Bulgaria the seismic forces upon buildings increase up to 2 times, and for 42% - up to 3 times, for 50% - up to 5,4 times.
- With the Seismic Regional Division Map of Bulgaria, dated 1987, high requirements towards seismic stability of building structures and buildings are imposed in the whole country in respect of the new construction.
- Yet, the question remains open for fulfilment of these requirements in respect of already constructed buildings and facilities.

5. LEVEL OF SEISMIC RISK

According to the statistical data, at the end of 2000 there is about 230 million m2 build-up area in Bulgaria. Until 1987 about 85% of them have been constructed, i.e. 195 million m2 (in villages – 39%, in towns – 61%, respectively). Considering the fact, that seismically unsecured settlements account for 95% of the territory in Bulgaria according to the Regional Division Map of 1987, it is clear that a residential area of about 158 million m2 is threatened by eventual destructive earthquakes.

6. CONCLUDING REMARKS

For the purpose of reducing seismic risk on the territory of the country, for the regions with highest increase of seismic forces, after a special National Program, per priorities of sites with dangerous processes, residential buildings and more significant public buildings, there must be commenced:

- Concrete risk assessment,
- Structural strengthening of the most threatened buildings and equipments.

ACKNOWLEDGEMENTS

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B3 – Natech disasters risk management in France

Agnes VALLEE
Accidental Risks Division
INERIS (Institut National de l'Environnement Industriel et des Risques)
Verneuil-en-Halatte, FRANCE
agnes.vallee@ineris.fr

Abstract

France is subjected to several types of natural phenomena (floods, earthquake, landslides, storms, forest fires…) and to attacks potentially generated by human activities (industrial facilities, nuclear power plants, transportation of dangerous goods…). The natural and technological risks are managed in France, as regards prevention, protection, intervention, in order to limit their human and economic consequences. Furthermore, an industrial accident could be triggered by a natural event. This paper explains how France is prepared to face this kind of disaster (called "natech disaster"). The description of the French approach is illustrated by the feedback of two recent major events (storm in December 1999, flood in South of France in September 2002).

Keywords : Natech disasters, natural risk prevention policy, natural risk prevention plans, industrial risk prevention policy, safety report, France

1. INTRODUCTION

In France, a policy for major risks, like natural and technological risks, was developed in order to prevent these risks, and to limit their human and economic consequences.

France is indeed subjected to several types of natural phenomena, such as floods, landslides, earthquakes, avalanches, storms, forest fires, to which can be added volcanoes eruption and cyclones in overseas departments and territories.

On the other hand, human activities create various technological risks, associated with industrial facilities, nuclear power plants, dams, transportation of dangerous goods…

Recent events show that, when a natural hazard strikes, hazardous industrial installations are always at risk and can potentially cause severe damage to the environment and to the population, with knock-on effects that propagate in time and space. There is a need to consider these natech disasters (a technological disaster triggered by any type of natural disaster).

For the two major risks, natural and technological risks, the policies of prevention, the risk management, the actors… are relatively different in France. And it doesn't exist a specific management system for natech disaster. Nevertheless the natech disasters are taken into account, because connections between the two approaches can be made, as it is explained thereafter.

2. NATECH DISASTERS RISK MANAGEMENT

2.1. Natural risk management

Natural hazards can cause severe damage to the population and to the environment and to the population.

In France, the main orientations of the natural risk prevention policy are :

- to better know the natural events and their effects,

- to ensure a monitoring of the natural phenomena, and give the alert when necessary,
- to sensitize and inform the population on the risks and the protection measures,
- to take natural risks into account in the regulation and land-use planning,
- to make prevention works, and adapt existing and future buildings or installations to the natural phenomena,
- to be prepared for crisis situations,
- to deal with the compensation and reconstruction,
- to set up the experience feedback, in order to learn lessons from the exceptional natural events.

Natural Risk Prevention Plans (RPP), which were created by the law of 02/02/1995 (article L.562-1 of the Environment Code), constitute today one of the essential instruments of the actions of the State as regards prevention of the natural risks.

RPPs are the responsibility of the State. They are worked out by the Regional Departments of Environment (DIREN), the District Infrastructure Departments (DDE), the District Departments for Agriculture an Forests (DDAF)…After consultation for opinion of the citizens and local communities, the RPPs are then approved by the Prefet, which represents the government in the Department. The RPPs are annexed to the land-use planning (PLU) of the municipalities.

Drawn-up on the basis of present knowledge of risks, the RPPs help to direct development and to define prevention, protection and safeguard measures for occupied vulnerable areas.

The development of a RPP results in 4 principal phases:

- *informative phase*, where a collection of information (archives about historical events, interviews, on site observations…) on the studied natural phenomenon is made,
- *realization of a hazards map*, based on a qualitative approach, which classifies the natural hazards in several levels (strong, medium, low, negligible) by considering the nature of the natural phenomenon, the probability of the event and its intensity (an example is shown in Figure B3.a),
- *assessment of the stakes*, which results mainly from the superposition of the natural hazards map with the existent and/or projected occupied areas,
- *construction of a lawful zoning map*, and the definition of rules applicable to each of the different zones (prohibitions and restrictions for the new installations, prevention, protection and safeguard general measures, special measures for existing installations).

Ultimately a RPP can prohibit or subject to regulations all the constructions, including farms, industrial, forest, craft and commercial installations. It is an interesting way to limit the consequences of an natural phenomenon, and thus to avoid natech disasters.

Emergency plans are prepared by the Prefet of each department, in contact with authorities, services and organisations capable of taking the safeguard measures, and whose means are likely to be implemented to face the natural disasters.

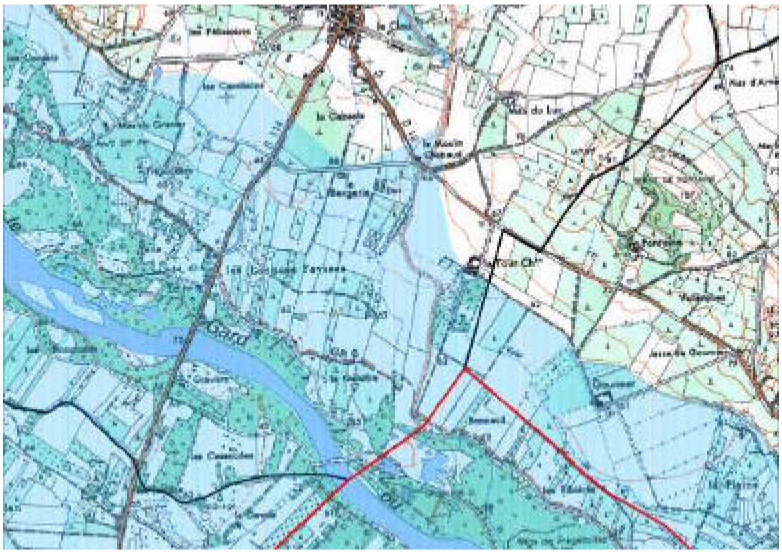


Figure B3.a - Example of an atlas of flooded zones.

2.2. Industrial risk management

The legislation relating to the classified installations for the environment protection (ICPE) is the base of industrial risks prevention policy in France. Apart from the nuclear installations and mines, which are covered by others regulations, the ICPE regulations concern all the industrial activities, the intensive breeding and the waste treatment installations.

The industrial installations are classified according to the properties of the handled substances or according to their activities. Table B3.a shows the various classes:

Table B3.a – Classification of industrial installations (Nomencalture).

According the substances (serial 1000)	**According the activities (serial 2000)**
• 1.1 : Toxic	• 2.1 : Agriculture ands animals
• 1.2 : Oxidisers	• 2.2 : Food industry
• 1.3 : Explosives	• 2.3 : Textiles, leather
• 1.4 : Flammables	• 2.4 : Wood, paper, pulp
• 1.5 : Combustibles	• 2.5 : Materials, mining products
• 1.6 : Corrosives	• 2.6 : Chemistry, rubber
• 1.7 : Radioactive	• 2.7 : Waste
	• 2.8 : Miscellaneous

Furthermore, according to its importance, the industrial establishment is said to be :

- in declaration,
- in authorisation (installations not covered by Seveso II, or covered by Seveso II lower tier),
- in authorisation with compensation (installations covered by Seveso II upper tier).

For the two last status, the industrial establishment need a permit to produce. The nuisances generated by the plant (chronic and accidental risks) have to be studied.

The chronic pollution (water, air, ground, noise…) are identified in an impact study report, and the accidental situations (fires, explosion, dispersion of a toxic cloud, environmental pollution) in a safety report.

The objectives of the safety report are:

- to identify and analyse the risks, whether their root causes are internal or external (natural phenomena, for instance),
- to assess the gravity of the major accidents identified, in terms of consequences lengths (safety distances),
- to justify the safety barriers which enable to reduce the level of risk of the studied installations,
- to supply information to enable internal (POI) and external (PPI) plans to be drawn up in order to take the necessary measures in the event of a major accident,
- to contribute to inform the staff and the potentially affected population,
- to provide sufficient information to the authorities to enable decisions to be made in terms of siting of new activities or developments around existing establishments (land-use planning).

The regulation (especially the decree n°77-1133 of September 21, 1977, and the circular of May 10, 2000) indicate that external attacks, therefore the natural risks, must be treated in the safety report. However it's important to underline that these texts do not propose practical method, but only very general instructions.

And only the lightning risk and the seismic risk are governed by particular lawful texts intended specifically for the ICPE.

The new law n°2003-699 of 30/07/2003, relating to the prevention of the technological and natural risks and to the compensation for the damages, requires that prevention plans have to be carried out for technological risks, like it is already made for the natural risks.

3. LESSONS LEARNT

The accidentology provided by the BARPI (one Department of the Ministry of Environment) shows that industrial facilities are vulnerable towards the natural risks (earthquake, floods, storm, etc., and that they can suffer more or less important damage, being able to lead to a major accident.

This paragraph presents 2 examples of natural events that have occurred in France and triggered technological incidents or accidents.

3.1. The storms on December 1999 in France

3.1.1 Date, location and description of the natural event

Two strongly storms crossed the country in December 1999:

- *storm 1*: 26 December 1999, at about 02.00, northern half of France (tip of Brittany, Normandy, Ile de France, Champagne Ardennes, Lorraine, Alsace),

- *storm 2*: 27 and 28 December 1999, at about 16.00, southern half of France, in particular, the western and central parts (southern Brittany, the Atlantic coast, all areas to the south of a line from La Rochelle to Mâcon, including the Mediterranean coast, and Corsica).

Figure B3.b shows a picture of broken or uprooted trees in a forest in France.

Figure B3.b - Broken or uprooted trees in a forest in France.

The conjunction of the tide and violent winds (storm 2) had as a consequence the flood of many industrial establishments, especially in the Gironde estuary, in the north-west of Bordeaux.

<u>3.1.2 Damage observed on the industrial facilities</u>

The observed damages on the industrial facilities were as follows:

- Flood in a hydrocarbon deposit in Ambès
  - Damaged electric installations (electrical equipment boxes, pumps, gas-detectors),
  - Basin of storm that was submerged,
  - Drainage pipes that were saturated and blocked,
  - The deposit's exploitation is suspended during 7 days,
  - The hydrocarbon separators were submerged, but had been cleaned 3 days before, therefore there was no pollution of the environment.
- Flood in a hydrocarbon deposit in Bayon-sur-Gironde
  - Damaged pumping station of the water network, used to fight against fire,
  - No more supply electricity,
  - The electric stations (high and low tension), the wharf, the boiler room, the retention dikes, the pumping stations (except the pumps of fertilizers), the offices didn't suffer from water,
  - No environmental impact.
- Flood of the thermal power station in Ambès
  - Flooded administrative and productive buildings, staff canteen, system intended to pump cooling waters,
  - Cellars flooded by sewers,

- A part of the pipes pits is drowned,
- The recovery tank of the drops overflowed, but the retention dike however functioned well,
- The hydrocarbon separators were submerged, product was spread in the environment.

- Flood in a alcohol production factory, in Ambès
  - Tanks of H2SO4, HCl and NaOH, located in basement, were spilled and emptied in the retention. Thus the products should have been pumped,
  - Loss of the processing system and the paper documents,
  - No electricity on the industrial site during 3 days.
- Flood in a manufacturing plant of fertilizers, in Ambès
  - The cuts of electricity threatened the cooling system of the cryogenic storage of ammonia,
  - The electricity supply of the plant was stopped during 7 days, the plant functioned for this period thanks to its own cogeneration,
  - Damaged loading arm, a empty wagon ran off the line, unusable railway.
- Flood in a LPG storage and cylinders filling plant, in Ambès
  - Fences, roofs, the railway and the monitoring system were damaged,
  - Damaged electric installations,
  - Activities of the plant stopped during 3 days,
  - No electricity supply, use of a power generating unit in substitution,
  - Cylinders were dispersed all around the establishment (up to 1 km).
- Flood in a plant of carbon black, in Ambès
  - Production stopped during 8 days,
  - Significant damage (two power generating units, electric equipments, pumps),
  - 300 tons of stored products were soiled by the flood,
  - Damaged railway,
  - No notable pollution of natural environment.
- Flood in a manufacturing plant of sodium chlorate in Ambès
  - The roof of a salt storage hangar and that of a building sheltering electric room flew away,
  - Flooding of the pumping station (electric and diesel pumps) of the water network, used to fight against fire,
  - No more electricity, the installations were set in safety,
  - Destruction of 10 km of railway,
  - The basins of water treatment and fire waters were drowned. Water containing NaCl flowed in the Dordogne, without notable impact.
- Food in surfaces treatment plant, in Muret
  - - Short-circuit, fire in a building,
  - - The rain water supply network was blocked, no environmental impact.

- Flood in the nuclear power plant, in Blayais
  - o Loss of the sources of auxiliary power supply (225 kV) on all the sections of the power station, and loss of electrical supply network 400 kV on sections 2 and 4,
  - o Damaged protection dam of the platform,
  - o 30 cm of water in the North-Western part of the power station,
  - o Flooded buildings : buildings containing the pumps of the rescued circuit of raw water, technical galleries, some buildings containing the electrical departures, bottom of the building containing combustible o sections 1 and 2,
  - o The flood damaged essential systems for safety.

3.1.3 Significant lessons learnt

The significant lessons learnt from this event are as follows:

- Authorities and industrialists became aware of the danger presented by a flood in this sector, where many dangerous factories are established.
- The DRIRE inspectors, who control usually the dangerous installations, asked the industrialists to change the safety report of their factory, by considering the scenario of flood.
- The development of a flood risk prevention plan began following this event.
- Industrialists took certain measures : to heighten installations presenting a risk in contact with water, to improve the circulation of water, to fix the cylinders, to build a wall around the room containing the equipment to fight against the fire…
- In the case of the power station in Blayais, an action plan aiming at reinforcing protection against the flood was carried out just after the event (dam of protection, alarm system, watertight partitions or systems…). Moreover one re-examination of all the French nuclear power station was made : checking of all the devices and procedures existing against the flood risk, re-examination of the design criteria relating to the flood risk.

3.2. Floods in Southern France in September 2002

3.2.1 Date, location and description of the event

It rained intensively in the South of France on 8-9 September 2003. A large geographical sector was concerned (approximately 6000 km^2), gathering the department of Gard, the east of Hérault and the west of Vaucluse. Figure B3.c and Figure B3.d show the extent of flooding in the South of France.

3.2.2 Consequences observed on the industrial facilities

The industrial facilities (laundry, chemical and pharmaceutical industry, wine cellar, etc.) were affected by floods. The companies were more or less affected (property damages, financial losses, etc.), depending on their geographical location.

Figure B3.e and Figure B3.f show examples of observed consequences of the flooding in Southern France:

Figure B3.c - Flood in the South of France, September 2002 (1).

Figure B3.d - Flood in the South of France, September 2002 (2).

Figure B3.e – A flooded wine cellar.

Figure B3.f - A domestic LPG tank.

In fact, there was no major accident caused by the flood, but several incidents which could have led to a major accident.

The only environmental impacts were:

- Increase in the turbidity of water,
- Spreading of a lagoon by low wall breaking,
- 2 tanks containing respectively bleach and acetic acid were spilled (small quantities).

It was noted that:

- for the crisis management, the authorities gave the priority to the rescue of populations,
- no particular alert was addressed by the authorities to the dangerous industrial facilities,
- the DRIRE inspectors, who control usually the dangerous installations, had difficulties contacting the facilities during the days after the flood, in order to know if incidents had occurred,
- the majority of the companies are not informed of the existence or not of a flood risk prevention plan on their municipalities,
- some rare arrangements had been taken before September 2001, in particular on industrial sites which had already been flooded : work, construction of the offices, the machines, the electric equipments and storage of dangerous products, in areas not reached by the flood,
- generally, the production was stopped, the installations were set in safety,
- there were network cuts (cuts of gas and electricity, unavailable telephone, plants entrances blocked…),
- after the flood, the industrial installations need to be cleaned and restored.

<u>3.2.3 Significant lessons learnt</u>

Interesting lessons were learnt about this event.

The possible improvements are stated below:

- Necessary alteration works (construction of dams, cleaning of the rivers, etc.),
- Better knowledge of the natural event,
- Good functioning of the means of communication and various networks (electricity, gas, water, roads…) during and after the crisis,
- Taking into account the consequences of floods on industrial facilities.

4. CONCLUSIONS

The Ministry of Environment, with the assistance of INERIS (Institut National de l'Environnement Industriel et des Risques), is reflecting to improve the way of taking into account the natural risks for the dangerous industrial facilities.

B4 – Natech Disaster Risk Management in Bavaria

Bernd ZAAYENGA
Bavarian Ministry of the Interior
Odeonsplatz 3, D- 80539 Munich, GERMANY
bernd.zaayenga@stmi.bayern.de

Abstract

This paper describes what type of data is collected in order to assess natural and technological risks, particularly in alpine areas. It also explains which data are visualised on risk maps used in Bavaria, Germany. Then it describes some key legislation which dictate the terms of references of various actors in the field of disaster risk management in Bavaria. Special attention is given to the description of special disaster control plans, along with types of plans available on the territory. The importance of timely warning to the public has been highlighted, based on the experience gained from recent flood disasters.

Keywords : Natech risk, catastrophe, Seveso II, risk mapping, warming and alert systems, monitoring systems , alpine risk, special plans, Germany,

1. NATECH RISK ADMINISTRATION IN GERMANY

The influence of natural and extreme natural phenomena (heavy rain, hurricane, and thunderstorm) leads to catastrophes, which are often created by man. Frequently it is the deficits of human condition that transform a natural phenomenon into a natural disaster, e.g. construction of dangerous industrial plants in risk areas, construction of residential areas in natural hazard-prone areas, destruction of natural compensation areas, construction of a delicate infrastructure, etc..

Territorial management can no longer be sufficient when there is a high concentration of risks, which could result in devastating consequences in a given area. By an integrated system of prevention and punctual warning and information dissemination, damages caused by a natural disaster (e.g. loss of human lives and economic damages) can be frequently reduced considerably.

Natural phenomena cannot be prevented, but the effects on the population and industry can be reduced or at times, eliminated. To this it is required that existing risks are recognized and judged and the right conclusions are pulled from the judgment, which then have to be converted into measures to be applied on the territory.

2. JUDGMENT OF RISKS

2.1 Recording and mapping of risks

Every relevant catastrophe is evaluated in the Federal Republic of Germany. The knowledge and experiences are transformed in special measures and/or disaster control special plans, e.g. after the August floods of 2002, the federal states of Saxony and Saxony-Anhalt were able to evaluate and reconsider their emergency plans and preventive measures so as to be better prepared for the future and thus minimise the damages of the next inundation event. In a study entitled "risks in Germany", the Federal Ministry of the Interior for Civil Defence (ZfZ) envisages to include and to describe relevant risks for possible unusual dangers and damage situations with national relevance, with view to civilian safety precautions.

In Bavaria, the following risks are represented on maps: alpine hazards, including floodplains, nuclear and industrial installations and their potential impact range, burnt area of past forest fires, etc.

Maps can be the basis of special plans on disaster control, as they assist in visualising the potential areas at risk and thus, allow the creation risk zones.

2.2 Alpine risks

Since the end of July 2003, the "nature driven alpine information system" (IAN), has been available on the internet for the public. IAN is based on a Geographic Information System (GIS) which allows visualisation of alpine hazards, such as avalanches, floods, mudflows, slips and rockslides. It has a user-friendly interface, enabling the user to speedily have an overview of possible risks in a certain area. It is important to not that it has not been set up to obtain the exact analysis of risk nor the detailed evaluation of potential consequences. These tasks are left to the specialists for each type of alpine hazard.

IAN stores different types of data and information needed by different types of analysis: water quality and quantity data, forest parameters, geological data, etc. These data are collected and maintained by different types of administrations: Water Authority, Forest Commission and Geological Office, respectively.

The following data are recorded, mapped and represented:

- ***Protection woods renovation***. The mountain woods are an essential resource that needs to be protected. Damaged areas are identified and new trees and vegetation are planted to substitute losses. The State Forest Commission enforces the renovation of lost woodland where required.
- ***Geological dangers***. Data about slope movements are recorded and evaluated, including deposition areas, type of slope movement and activity. They are represented on maps with scale from 1:5,000 to 1:100,000.
- ***Event documentation***. Past events (floods, mudflows, mass movements) that occurred in the alpine region are documented by the local water-supply and distribution offices. The information collected is analysed in detail by experts from Austria, Italy and Slovenia. They are working together in the project "D sharp nightmare" sponsored by the EU.
- ***Hydrographical morphological maps***. Maps of scale 1:25,000 are elaborated to allow the study of mass movements and erosion forms in torrent catchment areas. This enables to better understand the nature of various types of mass movement hazards, resulting in the preparation of adequate measures.
- ***Avalanches***. Each avalanche commission has the responsibility to identify the avalanche zones and calculate the frequency of the avalanches. The information collected is then stored in the regional avalanche database. Vulnerable areas, such as buildings, mountain railroads and ski lifts as well as highways, must be visualised in relation to the identified avalanche zones. The avalanche progress report, published daily in wintertime, together with the avalanche regional database, assist in obtaining an idea about local avalanche risk. The result of the analysis allows the elaboration of the required prevention and mitigation measures.

2.3 High water/flood areas

Extensive data are collected and published with respect to high water risks in Bavaria. These are in particular:

- ***High water news service***. There is a flood news service, which provides information to the public regarding flood risk. It uses a classification scheme of flood risk degree.
- ***Reporting plans of the communes***. Flood reports, based on the monitoring of water levels, assist in elaborating protective measure plans for communes.
- ***Flood areas***. By 2006, the 100-year flood must be calculated for all rivers of first and second order, as well as important third order rivers in Bavaria. These hazard maps must be 1: 5.000 in scale. The information has to be published following a specific method used in Bavaria.
- ***Flood-prone areas***. In 2003, flood information along with maps of potential flood risk areas with a scale of 1:25,000 were made available to the public via the internet.
- ***Preferential pathways for floods***. In the context of regional planning, preferential pathways for the discharge of floodwater are determined and are represented on regional maps with a scale of 1:100,000.

2.4 Mapping risk around nuclear plants

It is necessary to assess the potential area that could be affected by a nuclear accident. Based on the potential consequences evaluated, catastrophe protective measures need to be taken. Such measures can be elaborated by drills carried out by radiation detection teams. Every team has to use maps in which the area is divided up into zones and sectors. Sampling measures are carried out and, if necessary, the journey routes are recorded on the maps and described in report. The number of samples taken depends on: local situation and size of the nuclear installation (e.g. approximately 5 to 20 samples in the central zone near the nuclear plant; approximately , 3-6 samples in the outer zones.

This drill example became the basis of the elaboration of the Bavarian alert and response management plans, as well as the setting up of disaster control measures for nuclear accidents (as stated in the Bavarian Ministry of the Interior Decree 10-16-1990, AllMBl 1990, p. 780 pp.). This provided the terms of reference and guidelines for the disaster control authorities to prepare emergency preparedness and response measures.

An example of a radiation map showing the potential extension of a nuclear accident accompanies the above-mentioned guidelines. It is based on the recommendations prescribed by the Organization of the Environment of Nuclear Installations, which portrays the zones and sectors (e.g. 25-km-periphery around the nuclear power stations, 10-km periphery around the research reactor Munich Garching), and also forms the basis for the planning of all other disaster control measures during nuclear accidents.

Radiation maps for the nuclear power stations in Bavaria are found in the scale of 1:250.000 (e.g. Gundremmingen, Grafenrheinfeld, Isar I and II as well as research reactor Munich-Garching), and are available for all to use.

2.5 Businesses according to the Seveso-II guidelines

In line with the UNECE industry accident convention, a map been created in Bavaria which allows the visualisation of operating ranges with extended duties according to the Seveso-II Directive, along with dangerous activities which can potentially have cross-border consequences. These have been made in case of a disruptive incident or a serious accident. In particular, this has been carried out along the borders with Czech Republic Austria and Switzerland. A 15-km radius has been delineated with respect to the potential aerial dispersion, whilst a related delineation is carried out for the potential water dispersion for border areas that are part of the same river catchment. The map has a scale of at least 1:500,000. This has been the task carried out in Bavaria in cooperation with neighbouring authorities at regional and national level.

In agreement with the Seveso II Directive and the UNECE industry accident convention, the operating ranges are fixed with extended duties or dangerous activities according to the danger potential of the handled substances.

The map is checked and updated at regular intervals in order to record and visualise the real conditions.

Based on the Seveso-II Directive or the UNECE industry accident convention, the operators of the appropriate operating range or dangerous activities must inform the population potentially at risk about security procedures and right behaviour, in case of an accident. In accordance with the Seveso II guidelines, the areas which could potentially be affected by a serious accident have to be well identified and described in a safety report available for public consultation (there are some exceptions).

2.6 Forest fire use cards

For fast and coordinated forest fires fighting, suitable maps with a scale of 1:50,000 accompanied by UTM bars are available for the fire departments, particularly used for fire-prone woodlands.

The following details have to be portrayed on the forest fire maps:

- streets and roads within allowing the passage of heavy freight vehicles (one or double-lanes outside the woods), along with easily accessible parking areas;
- key assembly points related to difficult locations in the woodland area;
- possible heliports;
- suitable water sources also outside the woods:
  - waters which are suitable for the water withdrawal by helicopters with deleting water outer burden containers,
  - other open waters,
  - hydrants.
- inventory of huts or buildings located in forest fire prone areas, along type of vegetation and tree (to give indication of degree of flammability).

If necessary, forest fire specific map information is collected by the forest authorities with support of the responsible local fire department. The production and distribution of the maps is carried out by the regional governments, in cooperation with the forest management authority.

2.7 Maps for railroads

There are railroad map which include those network where dangerous goods are transported. However, these maps are not exclusively suitable for transportation of dangerous goods hazard, but are more useful for fire accident. The maps are easily accessible and are available to the public at the scale of 1: 25,000. The maps for railway yards are provided by the German railroad network AG, which is an infrastructure enterprise. The map can be found in paper format. Eventually, they will be available in EDP format required for use by head offices of the police headquarters and the integrated regional headquarters. The maps a widely available and are used by alert centres, disaster control authorities, local authority operational centres, etc.

2.8 Pipelines

There are maps at various scales used to identify and visualise pipelines in Bavaria, as well as diagrams for the establishment of pre-planned oil barriers.

3 CATASTROPHE PRECAUTION MEASURES

An essential component of catastrophe prevention is to recognize, to assess and prepare for risks. *Disaster control plans* and *special disaster control plans* are required for especially vulnerable objects or events. Timely warning and/or adequate information would be necessary for a successful disaster defense.

3.1 Alarm planning and Alarm system

In Bavaria the EDP system BASIS, which contains a model that assesses different possible damage scenarios, alerts the task forces when required. Alarm plans are available to task forces along with accompanying resources. Certain arrangements also exist for uncertainty phases.

3.2 General disaster control plan

All data and documents necessary for the successful disaster management are summarized in the general disaster control plan. The general disaster control plan is useful during the emergency as specific information source. In Bavaria, the general disaster plan is likewise provided by the EDP program BASIS.

3.3 Special disaster control plans

Special disaster control plans were made to address elements and issues that were recognised and judged to be potentially dangerous in Bavaria:

- critical motorway sections – especially during winter,
- dangerous industrial establishments,
- nuclear power stations,
- pipelines,
- airports,
- mountain railroads,
- train yards,
- floodplains,

- avalanche-prone areas,
- thunderstorm pathways (warning system in preparation),
- water supply systems,
- hospitals,
- old people's homes etc.

These special plans provide the measures to cope with each particular type of threat, along with the responsible authority that has the mandate to manage it and its potential realisation. Special alerting systems are also included in order to reduce the potential damage. This is the advantage of the special plans, as it provides a lot of information on what to do in case of a particularly dangerous event. It also provides a preparedness strategy which includes public awareness and educational schemes, along with drill exercises.

Based on the Bavarian disaster control law (BayKSG) or the Seveso-II directive, alarm plans must be elaborated for all Seveso II establishments, along with emergency plans. Here below are other important requirements:

- alert plans for special objects,
- fire department plan of action,
- self-help information for the public in case of an accident, along with other useful information,
- evacuation plan, if necessary.

The information found in these special plans have been provided by operators of safety reports, operators of internal emergency plans, along with other information specified by and in accordance with. BayKSG. This has to be made available to the district administration authorities by 3 February 2002, at the latest.

The Security Group (SGS), residing at the Bavarian National Office for Environmental Protection from the Hazard Potential, determined concentration ranges on the basis of the inventory of dangerous materials. Various potential scenarios were assessed, including those linked to terrorist acts. Corresponding measures were also elaborated.

The Bavarian National Office for Environmental Protection examines the data of the safety report operators. The data is then used to produce external emergency plans. Afterwards, the examined safety reports are transmitted to the agents in charge within the district administration authorities responsible for disaster control. These agents then prepare the external emergency plans on the basis of the checked and conclusive safety reports or, if the alarm plans are already available, they adapt them for the requirements of the external emergency plans.

In the Bavarian the Ministry of State, a disaster control planning team was established, which regularly checks the state of the external emergency plans, and if necessary, acts as the internal coordination unit amongst other inter-linked administrations called upon during an accident.

4. WARNING AND INFORMATION DISSEMINATION: EXAMPLE OF THE "THUNDERSTORM WARNING SYSTEM IN BAVARIA"

The last two devastating floods of Bavaria, i.e. the Pentecost flood of 1999 and August 2002 flood, clarified that the disaster control system in Bavaria was well prepared. In addition, it was found necessary to have a single storm warning system for the municipalities, along with the corresponding disaster control special plans at local level.

Moreover, these events have proven that a successful crisis management especially depends on:

- timely warning and sound information dissemination and ,
- prepared disaster control special planning.

4.1 Weather forecast and warnings

In the last years, the Bavarian State Department of the Interior developed a comprehensive storm warning system, in co-operation with the German Weather Service (DWD). In this framework, the German Weather Service, whose regional centre in Bavaria is situated in Munich, dispatches warnings during storms to the disaster control authorities via a designated fax machine. The warning is also sent other related services such as the police, technical welfare organisation, the Bavarian Red Cross, Forest Managements Centres and the German Federal Armed Forces. Thus all actors involved in storm risk and related disaster management administrations are notified within a few minutes. They all have protocols to follow with regard to making the necessary arrangement operational and institutional to take the necessary measures.

With the proclamation of Decree NR. ID4-3041-ç/71 (AllMBl P. 362), which was promulgated by the Bavarian State Department of the Interior of 19 April 1991, the warning to the population during an imminent storm became legally binding. Based on this legal act, by the German Weather Service has the responsibility to broadcast weather forecasts through the traffic warning service system.

With the established thunderstorm warning system, it is ensured that the thunderstorm warnings reach the disaster control authorities concerned, along with the other above-mentioned related organisations in a timely manner. This would then lead to the swift warning of the population with regards to a threatening thunderstorm.

When threatened by a thunderstorm, the warning system was primarily built with the use of boreholes to enable the disaster control and security services to prepare for them or to start timely and exact forecasts and warnings. It also feeds into the elaboration of required and suitable measures to avoid or to reduce human and material losses. Based on the summer 2002 thunderstorms that caused the severe floods across the country, developments to the warning system have been carried out by the Bavarian State Department of the Interior in collaboration with the German Meteorological Service, thus, the warning mechanism has improved.

The highlights of the main developments to the warning system are the enhanced "hit precision" of thunderstorm warnings, adequate forecasting of the area at risk and the integration of all municipalities into the thunderstorm warning system.

5. ADEQUATE FORECASTING OF THE AREA AT RISK, EXACT ADMINISTRATIVE DISTRICT WARNINGS

In order achieve this warning mechanism, the German Weather Service made various forecasts available (at the local level), via the Internet, to the districts concerned.

The aim of German Weather Service is to efficiently be able to warn, via fax, only those districts that are presumably threatened by an oncoming storm. This would substitute the older system of providing warnings to entire regions or governmental districts, where many areas may not be affected by the storm at all. With this newer targeted system, a better and considerably higher "hit precision" of thunderstorm warnings has to be expected.

6. THE KONRAD FORECASTING SYSTEM FOR THE BAVARIAN DISASTER CONTROL AUTHORITIES

KONRAD is a system for thunderstorm forecasting, which was developed at the Hohenpeißenberg Observatory. KONRAD stands for the Convection development in radar products. It is detailed radar supported thunderstorm diagnosis and forecast system, which has been designed to particularly monitor thunderstorm situations. From the data of 16 radar gauges of the German Meteorological Service KONRAD provides reliable forecasts about the progress of a given thunderstorm within the next half hour and allows its visualisation on a PC monitor. The consequences of a strong thunderstorm or heavy rain can be better assessed and more exactly represented with the system (see Figure B7.a).

After a test phase for different disaster control authorities and fire departments, the prerequisites to make KONRAD accessible to all Bavarian disaster control authorities was achieved in June 2003. This was carried out in collaboration with the German Meteorological Service. With the development of KONRAD, storm warning in Bavaria has been further improved. As a consequence, short-term alert and warning systems can be set up, along with the elaboration of adequate measures. The warning is to be converted then into municipality-referred disaster control special plans, including alarm plans for special units, persons and vulnerable elements.

7. INTEGRATION OF MUNICIPALITIES INTO THE THUNDERSTORM WARNING SYSTEM

Thunderstorm warnings of the German Meteorological Service reach the population as well as disaster control authorities, police, technical relief organisations, the Bavarian Red Cross, the forest management centres and the Federal Armed Forces.

However, the lessons learnt from past storm events made it clear that at district level, substantial protection and precaution measures can be carried out quickly and in a targeted manner. As a rule, only the responsible local municipality knows whether locations or events (e.g. youth camps, markets, etc.) exist, which are susceptible to a particular degree to an approaching storm. This is in their scope of responsibility. With the help of the thunderstorm warning system, it is also necessary to inform the municipalities about an oncoming storm. In addition, the storm warnings from the German Weather Service must reach competent authorities in the municipality in suitable form and in a timely manner. This will allow them to fulfil their tasks as a security authority in order to maintain public security and order by protecting the public from dangers, by prevention measures such as the removal of dangerous disturbances.

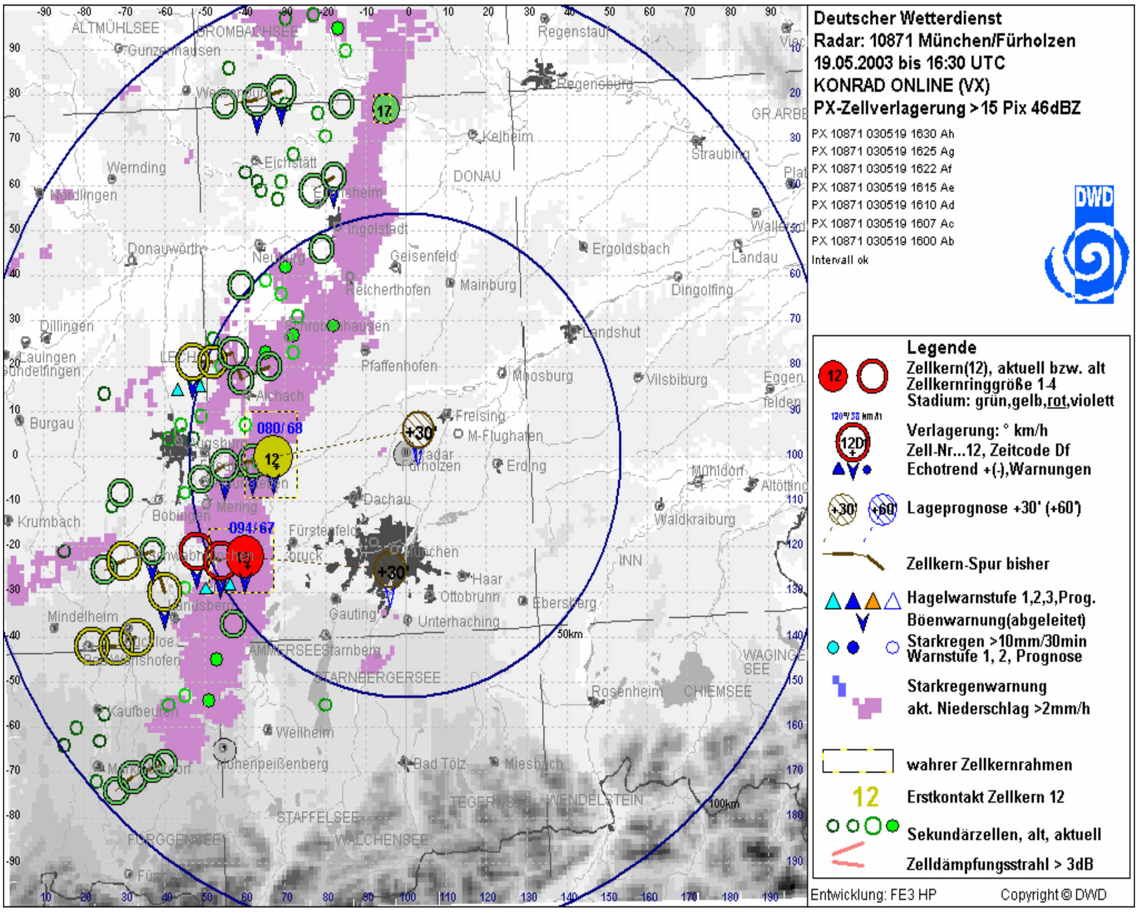


Figure B7.a – The KONRAD system forecasting the developments of an ongoing thunderstorm.

During 2003, the storm warning system was integrated into the alert system of the fire and disaster control units. This was carried out by each district administration authority. In the various fire and disaster control centres of each municipality, alarm plans and storm alert maps. All actors collaborated in achieving this integration (e.g. mayor, municipality co-worker, fire-brigade, building yard operators, crisis centre operators, etc.). If a storm warning is received at the respective alarm centre, the storm alarm map tempest is created and is circulated to the key actors in all affected municipalities, informing them to react to this storm warning and carry out the necessary measures. Within this framework, in order to avoid overloading the telephone systems with calls, it would be wise for people to have radios ready at home in order to receive storm warning and relate information in an alternative manner.

The contents of the thunderstorm warning have been established to provide the municipality with adequate information about the oncoming weather development. It should assist them in formulating the required measures which are described in the following section.

8. DISASTER CONTROL AND PROTECTION FROM DANGER

A tempest warning can only serve its full purpose if a disaster control special plan is locally activated, leading to protection of the population, property (private and public) and economic activities. It must be highlighted that it is the local municipalities that have the best overview of the potential effects of a given thunderstorm (including floods). It is then important that the municipalities cooperate with the responsible disaster control authority in order to set up the necessary measures, including the activation of alarms plans, which need to be coordinated, specified and prepared.

After receiving a tempest warning, the municipality decides and prioritises, e.g. where, when and who to evacuate first, which stage of the disaster control special plan should be carried out, etc. It then informs the competent authority concerned, e.g. alarming authority in the fire brigade and/or the disaster control centre, initiate the appropriate alerting of the population. Sometimes the information flux could go the other way, i.e. the disaster control authority could receive the initial warning from the German Weather Service, who in turn alerts the municipalities.

During 2003, the Bavarian State Department of the Interior coordinated the production of the storm disaster control special plans described above.

B5 – Natech Risk Management in Portugal

Catarina VENÂNCIO
Patrícia PIRES
Carlos MENDES
National Service for Fire and Civil Protection
Natural and Technological Hazards Division
Avenida do Forte em Carnaxide, 2799-512 Carnaxide, PORTUGAL
catarinav@snbpc.pt
patriciap@snbpc.pt
cmendes@snbpc.pt

Abstract

Portugal has no history on Natech events. Therefore, no specific surveillance or management system is available. However, on the scope of Civil Protection actions, there are some tools created to help decision-makers in their work during an emergency caused by a natural or technological disaster. In this paper, we'll detail some information about the management of seismic risk, pipelines and Seveso II establishments and flood risk. In addition an "almost Natech" event is described: a flood in Mondego basin almost triggering a pipeline collapse and gas release (January 2001).

Keywords : natech events, risk, civil protection, Seveso II, flood, earthquake, Portugal

1. INTRODUCTION

Although Portugal is usually submitted to several natural risks, such as floods, strong winds or forest fires, this country never had, so far, a Natech disaster. However, some possible Natech risks are:

- Earthquakes or landslides triggering industrial accidents, pipeline collapse or dam breaks;
- Forest fires triggering fires in chemical plants or in separate storages located near forestland;
- Floods triggering leaking of dangerous substances from chemical plants or triggering pipelines buffer soil erosion and possible collapse.

2. SEISMIC RISK MANAGEMENT

The Portuguese Continental territory places in the Euroasiatic plate, limited to south by the Azores-Gibraltar fault and, to the west, by the mid-atlantic ridge.

In a general way it can be affirmed that Portuguese territory have a moderate sismicity characterized by long return periods associates to a great magnitude.

The metropolitan area of Lisbon and the Algarve region, in the south, are the two most important seismic zones of the Portuguese Continental territory that suffered more intensively the seismic effects (see Figure B5.a).

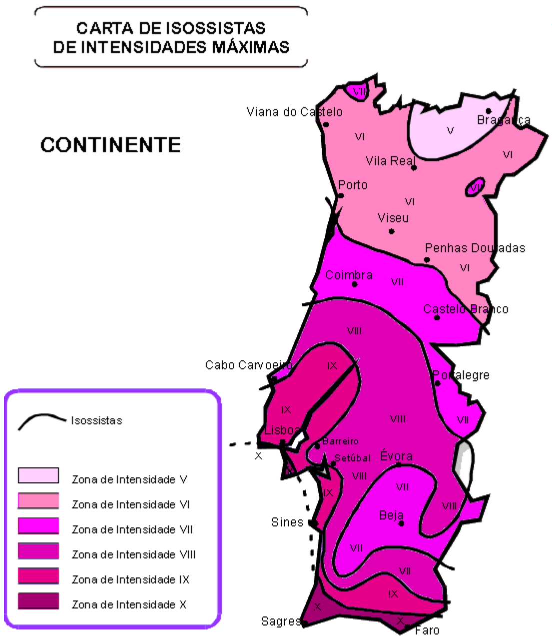


Figure B5.a – Maximum Historical Intensities – 1755 earthquake (Mercalli Modified Intensities).

By request of the Ministry of Internal Affairs, the National Service for Fire and Civil Protection (SNBPC) coordinate, since 1997, a project to study the seismic risk in the metropolitan area of Lisbon and surrounding municipalities, which main goal is the emergency contingency plan to face this risk.

This area was first selected due to its national socio-economical importance and demographic density.

This project has the collaboration of several Portuguese research institutions (three Universities, a national research laboratory - National Laboratory for Civil Engineering and an enterprise specialised in Geographic Information Systems).

The final product result of the project is a simulator of seismic scenarios based on a GIS system, containing all the available information on geophysical, geological, housing, important structures, lifelines of all kinds, population, etc.

This simulator, for a given event or collection of events (each characterised by a magnitude, an epicentral location and a date, associated to a probability of occurrence) produces information on damage to all different objects under study and on human casualties. Vulnerability assessment was essentially based on the Hazus- 99 methodology.

The project gathered all the data (work unit: county), including for example: estimation of the population mobility for different hours of the day (week, weekends, holidays, etc.); study the influence of soil superficial layers on amplification of seismic waves as well as the potential for liquefaction and landslide, based on bore-holes available at many locations; and determining housing properties based on the building and population Census.

The GIS implementation allows visualising and analysing quickly the damage scenario picture obtained for each simulation and its geographical distribution. It is based on these results that the emergency contingency plan for seismic risk is now being developed, trying to optimise the crisis management.

To illustrate the potentialities of the developed work was chosen a scenario based on a historical earthquake of 1531, with epicentre in the fault of Vila Franca de Xira and magnitude 7 in the scale of Richter (Figure B5.b).

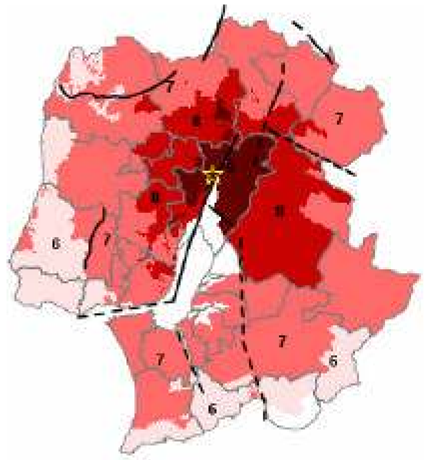


Figure B5.b - Tectonic and generated intensities (Mercalli Modified).

Figure B5.c and Figure B5.d present some results corresponding to the building park and the population affected by the seismic activity.

Severe damage – Total 8626 | Collapses – Total 2152

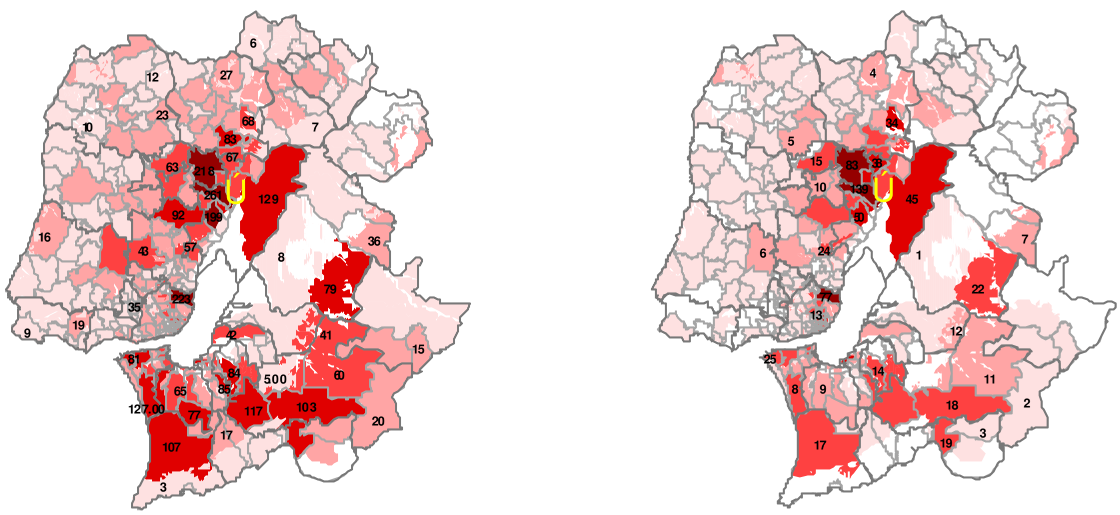


Figure B5.c – Damage on the building stock.

Now, that this project has finished, in 2002 a similar project was launched to the Algarve, with the same goals and using the same methodologies. It counts with the collaboration of the same project team and with more three other scientific entities. This region has a lot of tourism (national and international) and therefore requires a strong seasonal study of demographic variation, sources and destinies. Due to the different demographic distribution the unit of study is the statistical "section", smaller than the smallest administrative territorial division.

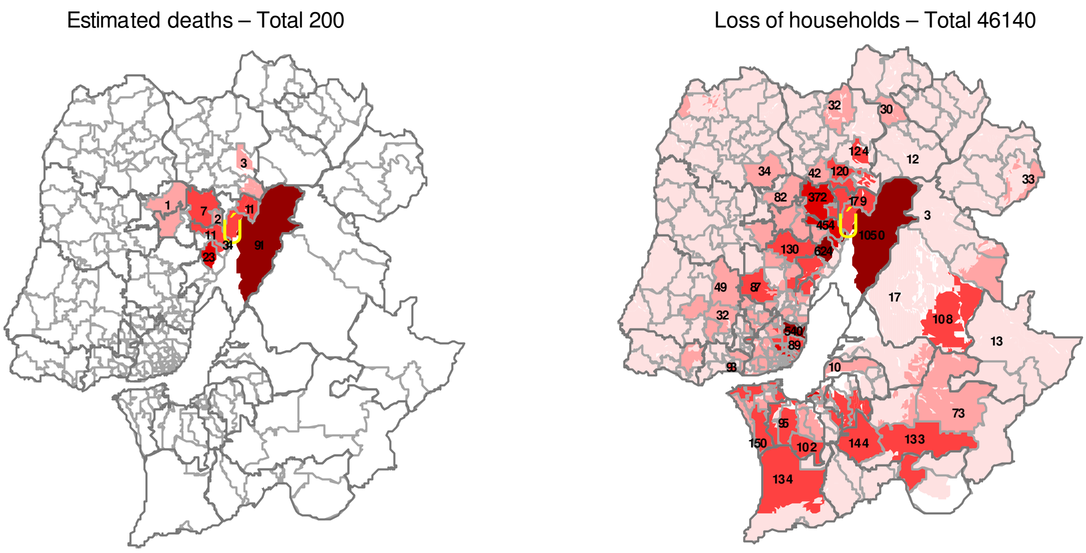


Figure B5.d - Damage to population.

The estimate of damages presented by the seismic simulator only respect the primary effect. The damages can be seriously increased if occur fires, tsunami, rupture of dams, rupture of pipelines and by the effect caused for the replica being able its effect to happen on the population.

3. PIPELINES RISK MANAGEMENT

In Portugal there are two major pipelines in operation: a natural gas pipeline and a fuel pipeline. The gas pipeline starts near the border, with natural gas provinient from Magreb, injected in the pipeline that cross the spanish territory. From here, gas is distributed in several lines in Portugal, crossing 13 districts and several municipalities (figure 5). The fuel pipeline transports fuel, gasoline and LPG from a refinary located in Sines (south of Portugal) to a storage plant located in Aveiras de Cima, in the metropolitan area of Lisbon (Figure B5.e).

The companies responsible for those pipelines have developed studies related with safety and emergency planning, where it is possible to predict affected areas in case of pipeline rupture (Figure B5.f). The emergency plans have also been developed, describing some procedures in case of emergency.

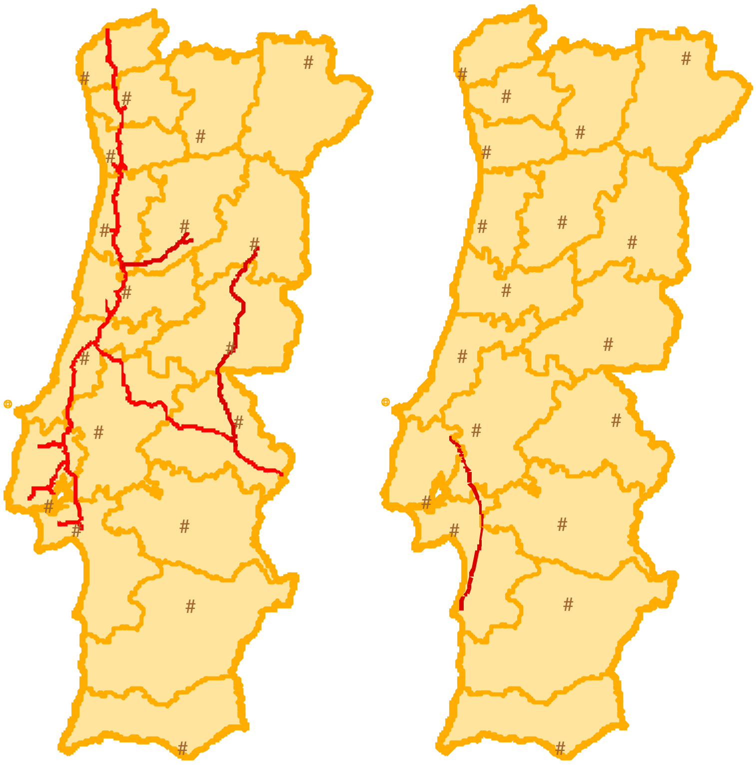


Figure B5.e – Gas pipeline and fuel pipeline in Portugal.

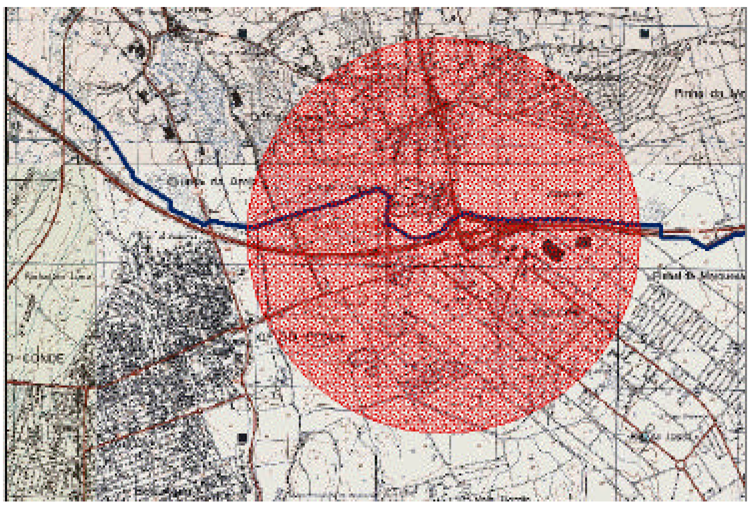


Figure B5.f – Estimated affected area in case of rupture in gas pipeline.

4. SEVESO II ESTABLISHMENTS RISK MANAGEMENT

In Portugal there are about 112 establishments covered by Seveso II Directive, and 50 of those establishments are included in the upper tier. In general, these establishments are located near the coast (Figure B5.g).

Natech events are not contemplated in ordinary hazard analysis, but some Natech prevention and mitigation strategies are implemented due to legislative restrictions. In some industrial plants, affected with particular natural risks, special measures are implemented to prevent Natech hazards.

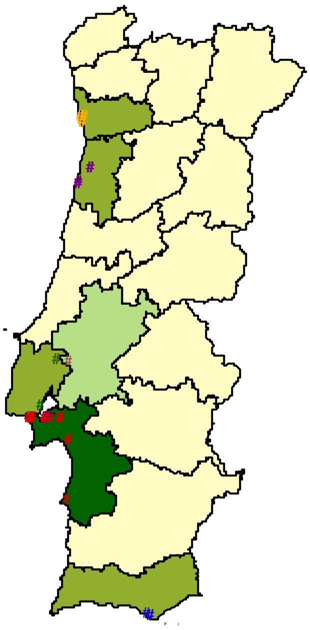


Figure B5.g - Upper tier Seveso II establishments.

Legislation concerning seismic activity is analysed when is build a new plant (Regulation of Security for Structures - RSA, 1983). Construction is made concerning seismic risk class - A to D (Figure B5.h).

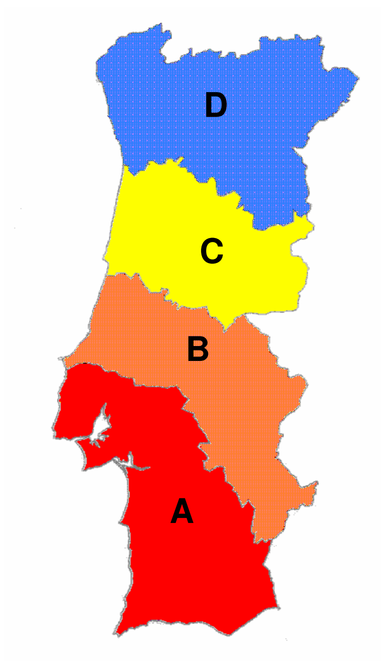


Figure B5.h – Seismic zoning of Portuguese Continental territory (RSA, 1983).

4.1 Landslides

A gas and liquid fuel terminal, located near Lisbon, was constructed in several platforms in different levels, resulting from excavations in batters in south bank of the Tagus River. Another platform with fewer dimensions was constructed in a bench terrace.

The location of this terminal in areas with high slope can represent some danger, so some measures were implemented to prevent landslides risk.

In the establishment some vegetation was planted to fix land and were built retaining walls in higher slope areas. In all plant area was implemented a land drainage system to rainfall and to avoid water in soil. The freatic lever of water in soil is monitoring and the National Laboratory of Civil Engineering assesses landslide risk. To prevent landslide and seismic damages, LPG storage tanks have also a support of 18 m foundation pile.

4.2 Seismic activity

In LPG subterranic storage in Sines, monitoring of seismic activity is done with 3 seismographs.

5. FLOOD RISK MANAGEMENT

In Portugal, water management during flood time is performed in close partnership between Civil Protection, the National Water Institute and the Portuguese Meteorological Institute. There are also permanent contacts with dam owners and Spanish authorities, in this case to ensure the adjusted management of flows in transboundary rivers. During flood time, there is also a Permanent Committee for the management of dams, in which the SNBPC is represented.

Due to a cooperation agreement, Civil Protection access to real-time data from more than 60 meteorological stations spread all over the country. In order to support decision-makers actions, there is also a continuous cooperation about weather forecasts (short, medium and long-term forecasts) and known consequences of meteorological events. Satellite and radar images are also available.

Additionally, Civil Protection accesses to a Surveillance and Alert System (sustained by the Water Institute) in order to have a permanent analysis on the water resources (see Figure B5.i). This system allows Civil Protection to follow the evolution of the hydrological situation in Portuguese main hydrographic basins, in a real time basis.

The Alert and Surveillance System for Water Resources has information available. For instance, data concerning dams (shown with a green triangle), such has incoming flow, stored volume or effluent flow. There is also information concerning hydrometric stations (green circles) usually located in critical points of the river.

Data are updated every 15 minutes for hydrometric stations and every hour for dams. This range of updates allows a better decision support, based in a real-time hydrological information.

An example of available information concerning dams is shown on Figure B5.j.

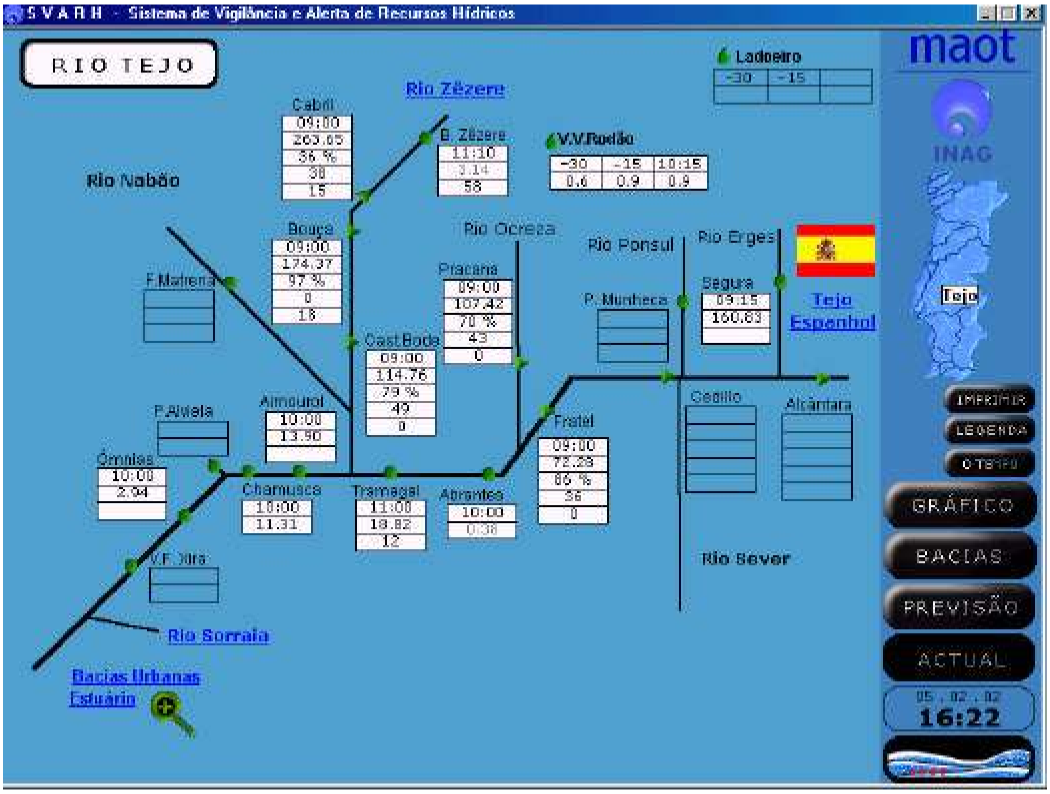


Figure B5.i - Alert and Surveillance System for Water Resources.

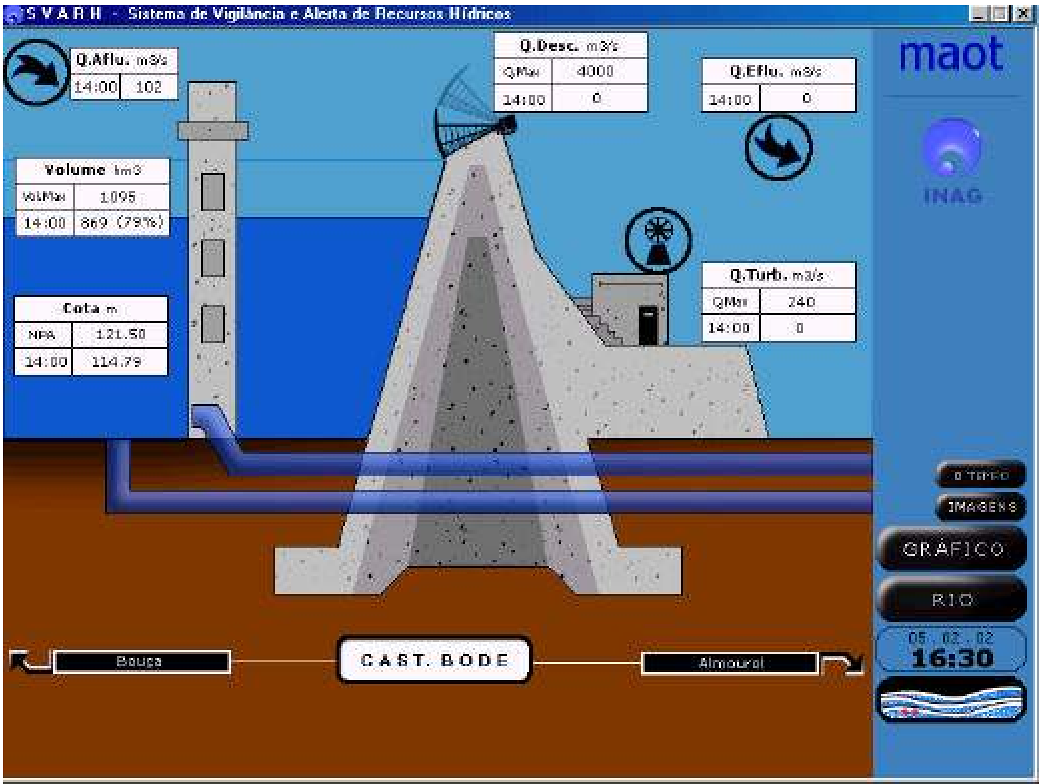


Figure B5.j - Information concerning dams, available in the Alert and Surveillance System for Water Resources.

For hydrometrical stations there is available data concerning the flow and the water level. Alert levels area also shown in a colour scale (green means a normal situation; yellow means a pre-emergency situation; red means an emergency situation). There are also marked the levels reached in other past flows (for instance, in 1978), in order to allow an easier comparison and a better support to populations and civil protection agents (see Figure B5.k).

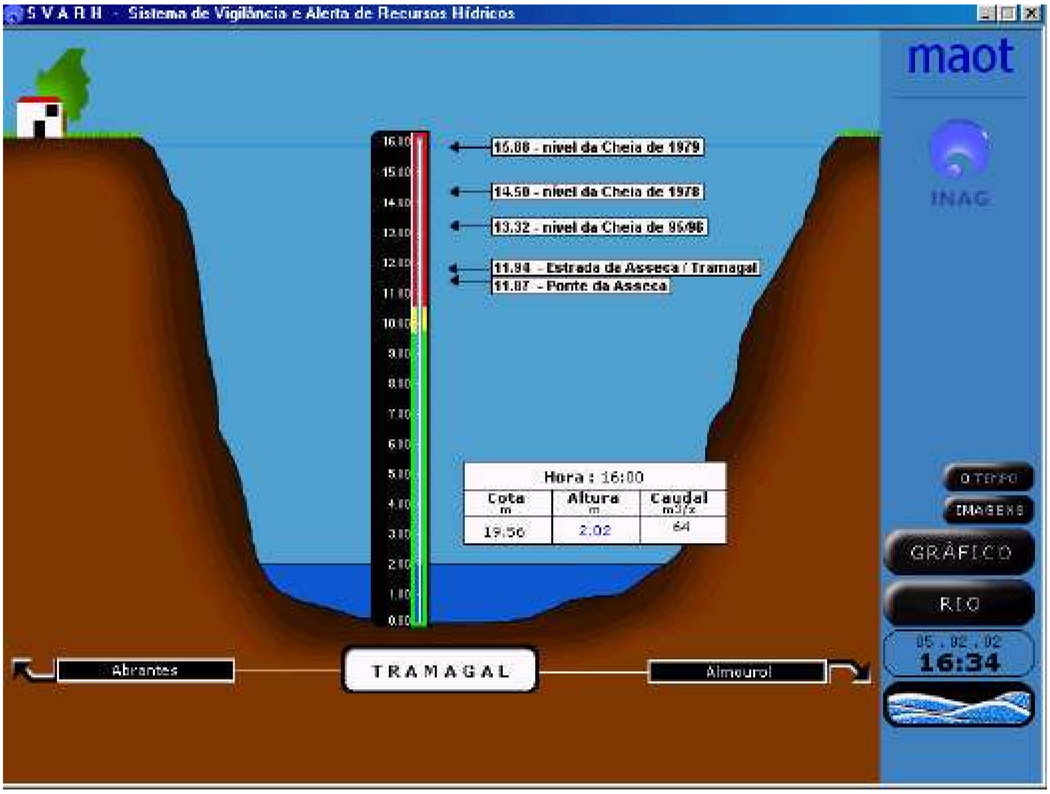


Figure B5.k - Information from rivers and comparison with known floods.

6. CASE STUDY: FLOODS IN MONDEGO

6.1 Mondego Basin

Mondego basin (see Figure B5.l) is the largest one concerning a river located integrally in Portuguese territory. The river born in Serra da Estrela mountain and finish in the Atlantic Ocean, near Figueira da Foz. Large floods in Mondego River have occurred in the past, affecting large areas downstream Coimbra (district capital), where population was already familiar with flood consequences.

In the 60's, a complex system of dams, channels and dykes was settled. The river course was changed into an almost straight line leading from Coimbra to Figueira da Foz, with the river banks being substituted by dykes, which guarantee that no flood will occur until an amount of around 2000 m^3/s.

The false sensation of security caused by dykes, led population to built new houses and construct new roads in ancient flooded areas, increasing risk to population.

Figure B5.l – Mondego Basin in Portugal.

6.2 2001 Floods in Mondego

In 2000, rainy season in Portugal started in November. During three months, Portugal experienced consecutive episodes of heavy precipitation. Water content in soil was very high, and therefore there was no chance of rainfall infiltration, which led to an increase in superficial stream. Additionally, water level rose in large dams forcing to emergency release of large amounts of water.

In consequence, several flood situations occurred in portuguese main hydrographical basins (Minho, Lima and Douro, in the North), Vouga and Tejo (in the Centre). The first critical flood situation occurred in the beginning of December 2000 and was followed by other floods, leaving no time for dryness established in the soil.

In Mondego basin, two flood episodes occurred in December 2000 and in January 2001. In both cases, dykes were submitted to a large tension, but they were able to contain the river inside the banks. Only a few hectares of agricultural soil were flooded. However, although there was no impact in population, the strong stream fragilized dykes, causing some leaks.

On the evening of 26 January 2001, after two days of rain, dykes started to collapse. During 5 days, dyke-breaks (caused by erosion and strong stream) succeeded along the final range of Mondego River causing floods in several towns and agricultural areas and leading to evacuation or isolation of more than one hundred persons. Additionally, many roads and railways become under water for some days.

Figure B5.m shows a set of photos taken of the Mondego Basin. The photo on the top left hand side portrays a part of the basin without floods, whilst all the other three photos show different flooded parts of the catchment. Figure B5.n shows the location of collapsed areas in dykes located on the banks Mondego River.

Figure B5.m - Floods in Mondego.

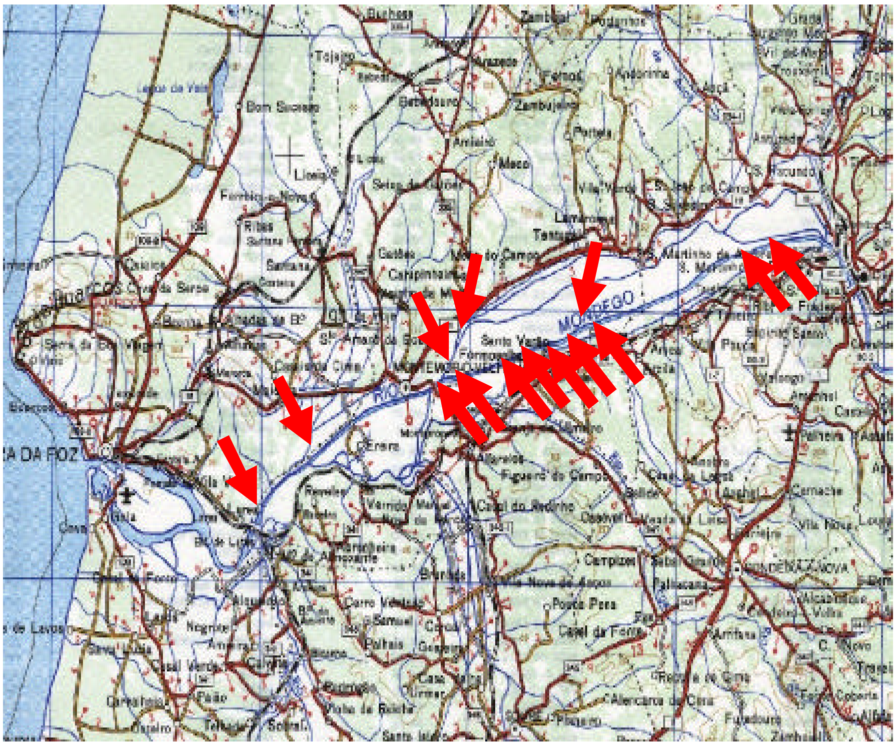


Figure B5.n - Location of collapsed areas in dykes located on Mondego banks.

During Mondego floods, water level in dams and stream near critical area were permanently monitored by the SNBPC. Acting as an interface between meteorological causes and hydrological effects, Civil Protection worked together with Meteorological

Institute and Water Institute in order to obtain up-to-date weather forecasts and real time data.

The National System for Surveillance and Alert on Water Resources was very important to spread available information onto district and municipal services of Civil Protection. For instance, data about water discharges in dams were easily accessed, allowing information to population located in downstream areas.

Flow management was also performed in other way. Knowing the extent of dyke-breaks, a maximum flow of 1200 m^3/s was estimated for the area downstream Coimbra, forcing Aguieira dam in upper Mondego to retain water. In next illustration it's possible to see that though incoming flow to Aguieira reached almost 1900 m^3/s, the maximum released flow was only 1115 m^3/s (this value occurred more than 24 hours after "natural" flood peak occurred, i.e., only after flow in small tributaries had decreased).

Figure B5.o portrays the comparison between incoming and released flow in Aguieira dam.

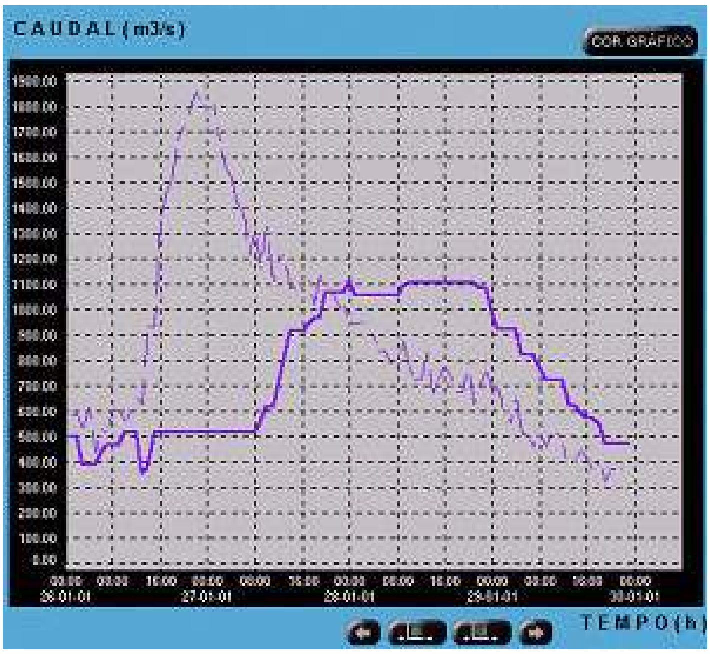


Figure B5.o - Flood management in Aguieira dam: comparison between incoming and released flow.

6.2 Natech event

Despite all the efforts to provide the best flood management possible, a Natech event started to develop: large flow erode buffer-soil located over and under a gas pipeline, leading to is appearance at surface. There was a risk of pipeline break and gas release, causing large risk to population, because the endangered area was located near Portuguese main motorway and also near some villages and the city of Coimbra.

In cooperation between Civil Protection organizations and agents, Water Institute and gas pipeline owner, emergency operations were made, such as the implementation of concrete footing to prevent pipeline from floating. Taking in account gas release scenarios, specific actions such as people evacuation or road-traffic suppression were considered, although they were not used.

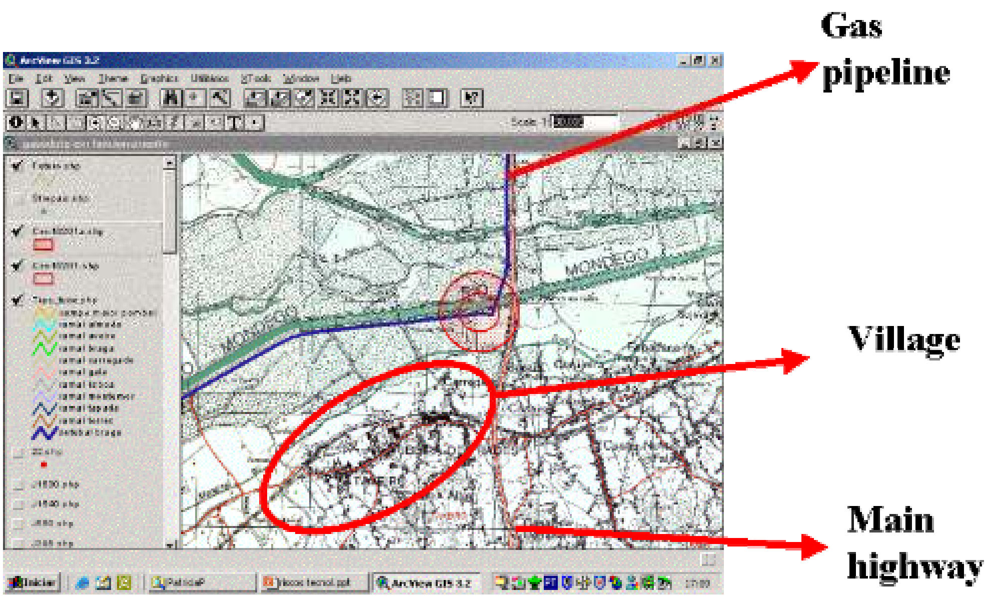


Figure B5.p - The gas release scenario.

6.3 Lessons learnt

- It is important to focus on the role of the Emergency Management Authority as the main coordination organization for Civil Protection Operations.
- There is a need to focus on the role of Civil Protection as an interface between scientific knowledge and operational issues.
- It is necessary to focus on the need of risk scenarios and updated geographical information.
- It would be advisable to focus on the need to update emergency plans.
- It is essential to improve articulation with organizations specialized in providing meteorological data (winds) and gas dispersion models.
- It would be useful to improve articulation between Civil Protection authorities at local, district and national level.
- Emergency solutions, such as recovery of dykes and pipeline stabilisation (implantation of concrete footing to prevent floating). Are very important.

B6 – Lessons Learnt from the Baia Mare Cyanide Spill (January 30, 2000, North-Western Romania)

Septimius MARA
Ministry of Agriculture, Forests, Waters & Environment,
Bld. Libertatii no. 12, sect. 5, Bucharest, ROMANIA
smara@pcnet.ro

Abstract

On 30 January 2000, at around 10 p.m., a dam broke at the Aurul Mine Tailings Recovery Plant near Baia Mare in north-western Romania, (due to liquid precipitation fallen on a thick snow layer). Approximately 100,000 m³ of a high cyanide and heavy metal containing wastewater were discharged into the receiving creeks, and from there onwards into the river network of the Danube Basin (Somes/Szamos; Tisza and the Danube). In the same region, another tailing dam broke in Baia Borsa on 10 March 2000, due to a severe rainfall spilling 40,000 tons of heavy metals-containing sediments. These two serious accidents with a transboundary impact initiated a rapid response within both the ICPDR and the EU.

The paper summarizes the most important activities undertaken by the Romanian authorities responsible for water management activities. These activities were undertaken in order to minimize the Natech accident effects and to assure the effectiveness of the corrective measures implemented, in order to avoid any further technical accidents triggered by natural events.

Keywords : Romania, dam safety operation, industrial waste deposits

1. DESCRIPTION OF THE EVENT AND CONSEQUENCES

On the night of January 30/31, 2000, heavy precipitation, about 35,7 l/m2 in 24 hours, and a sudden increase in ambient temperature, which was unusual for this period of year, results in the melting of a 43 cm thick snow strata that covered a settling pond. The melting of the snow results in an increase in the level of settling pond containing industrial waste waster with high cyanides concentration. Due to these conditions, a breach of about 25 m in the pond's dam was produced. Through this break about 100.000 m3 of water with cyanide is spilled. The cyanide containing water first reaches the Lapus River and then the Somes River. At theSatu Mare section, a maximum concentration of cyanides of 7.8 mg/l was determined, compared to 0,01 mg/l that represents the maximum permissible limit according to the Romanian standard for surface waters (see Figure no. 1).

Right after the accident the Romanian authorities adopted the necessary measures to stop the pollution and to inform the specialized authorities from Hungary. The population was also permanently informed about the possible effects of this accident.

The measures taken by the Romanian authorities were welcomed by the Hungarian authorities, which pointed out the good cooperation in this emergency situation.

SC AURUL SA Baia Mare was a joint Romanian-Australian Company, in which extacts gold from sterile disposals resulting from processing the ore with nonferrous metals at the Baia Mare industrial platform.

This industrial process follows Australian technology entirely, and became operational since September 1999.

The technology used for the gold extraction by SC AURUL SA Baia Mare is a new technology which was used for the first time in USA at the Homestake mine in 1971 and is presently used in Canada, South Africa, and France.

Figure B6.a - Location and the evolution of the cyanide pollution Natech event.

2. BACKGROUND OF THE PREVENTIVE AND PREPAREDNESS ACTIVITIES

In 1985, in the framework of the Bucharest Declaration, the riparian countries from the Danube River Basin joined efforts in order to strengthen water quality monitoring. This new approach was named TNMN or Trans-National Monitoring Network and was designed to improve the water quality management of the Danube River.

There is an Accident Emergency and Prevention Warning System (AEPWS) which consists of all Danube catchment areas from various subsystems in each of the riparian countries.

Every subsystem has a Principal International Alarm Center (PIAC), which is a part of the transboundary information network in emergencies situation.

PIAC has the following functions:

- *communication* – reception and prompt transmission of relevant messages in case of accidental pollution - 24 hours/day operation (using a satellite antenna system for sending info to surrounding countries).
- *expertise* – Assessment of the possible impact of the reported pollution on human health and/or the environment.

- *decision* – after identification of pollution, a decision is made about what institution to inform and what actions to be taken.

The Romanian PIAC, located at the Ministry of Agriculture, Forests, Waters and Environment, with on duty 24 hours (see Figure B6.b) at the time of the release (See Figure 2). During the cyanide Natech event PIAC dispatched 128 warning messages, first on January 31, 2000, to the similar PIAC in Budapest, Hungary, and the last one on March 02, 2000, to the Danube Secretariat in Vienna, when the cyanide pollution was totally diluted.

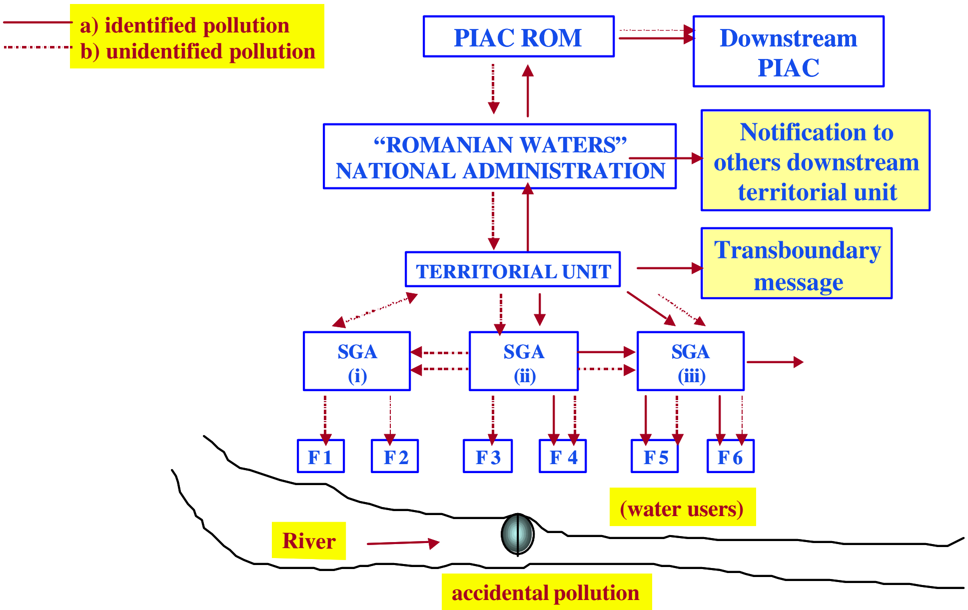


Figure B6.b - Primary information flow in case of a local accidental pollution (with transboundary effect) at the level of a hydrographical basin.

3. RESPONSE/INTERVENTION ACTIONS AT THE NATIONAL LEVEL

The Romanian Ministry of Agriculture, Forests, Waters and Environment has taken the following measures:

- Using the Principal International Alert Centre for Accidental Pollution on the Danube River (PIAC 08), all the downstream countries (Hungary, Yugoslavia, Bulgaria and Ukraine) were informed about this event, and also the Secretariat of the International Commission for the Danube River Protection from Vienna (ICPDR).
- It has permanently monitored water quality, and has assessed the effectiveness of the measures taken for stopping the pollution source.
- It has informed in the Baia Mare Court of Justice-Prosecutor's Office writing.
- It has organized an extraordinary meeting of the water quality Sub-commission within the Romanian-Hungarian Hydrotechnic Joint Commission, for the inspection of the accident location. The Sub-commission noted that there is very good cooperation between the hydrotechnical authorities of both Parties concerning the exchange of information and performing analysis on the state of pollution.

- It has nominated a commission of experts to analyze the safety of the settling pond protection dam and to establish any necessary measures. The conclusions of the Commission were analyzed within the Operating Office of the National Commission for the Safety of Dams and Other Hydro-technical Works. It was jointly agreed that the necessary measures should be applied in order to avoid future accidental events.
- A joint meeting with the Hungarian authorities was held in Oradea, on February 10, 2000. The circumstances of the accident and future cooperation measures to monitor water pollution in the Tisza River as well as common water sampling methodologies were discussed.

The territorial authorities of the Ministry of Agriculture, Forests, Waters and Environment, have taken immediate action including:

- ceasing the activity of AURUL SA;
- closing the dam breach;
- neutralizing discharged water from the settling pond with sodium hypo-chlorine;
- water sampling in order to determine the pollutants concentration and monitoring of the level of pollution through appropriate analysis;
- informing the Water Authority and Environmental Protection Agency of Nyiregyhaza (Hungary), in accordance with the provisions of the Bilateral Convention on the Transboundary Water Issues about the accident and about the imminent reaching of the pollution wave at the Hungarian territory (Please see Figure B6.c);
- alerting the local authorities of the affected water courses on the interdiction to use the river water for domestic needs, for animal-drinking water, or for fish consumption.

As a result of the measures taken, the water discharge from the settling pond was stopped from February 2, 2000, through the reconstruction of the affected protection dam. The problem treated with all the seriousness of purpose by the Romanian authorities. The affected water course was permanently monitored.

In addition, the following points need mentioning:

- The cyanide pollution does not have a remnant character, the concentration of the polluted water, which contains cyanides, decreases in higher water flow. Thus, on the Hungarian territory, after the confluence of Tisza and Mures Rivers , the cyanide concentration decreased to 0.38 mg/l compared to 7.8 mg/l, the maximum level registered at the Satu Mare control section on the Somes River.
- From the beginning of the pollution wave from the Danube River, passing through the Romanian territory, the local units of the Ministry of Agriculture, Forests, Waters and Environment organized a monitoring system, and together with the local state authorities took measures to stop local communities from using the Danube River for water supply.

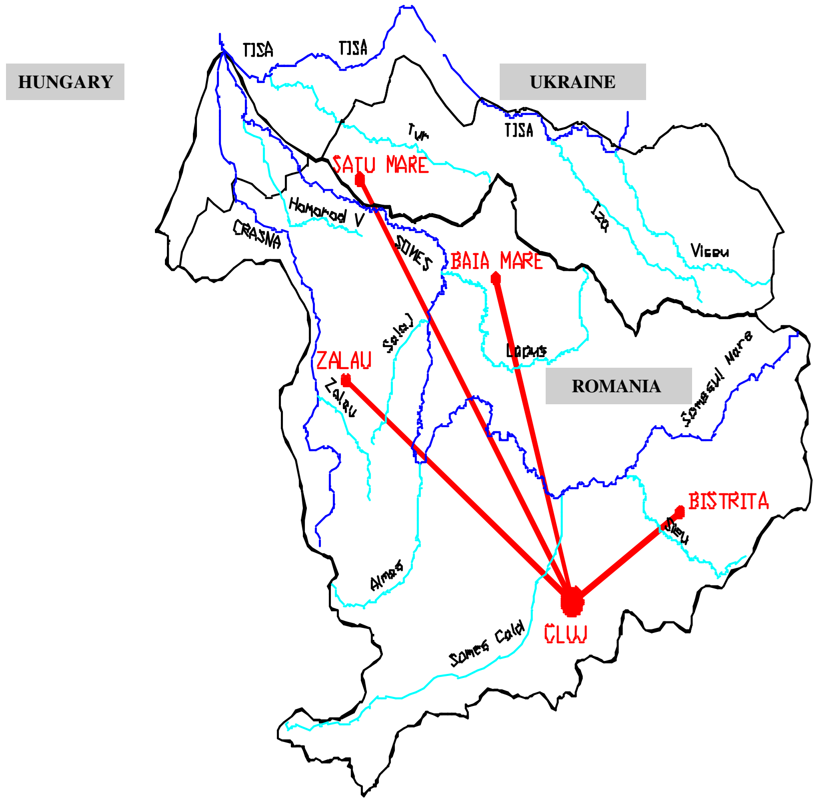


Figure B6.c - Informational flow in case of accidental pollution at Somes -Tisa Romanian Waters N.A. Direction (at Water Management Systems - SGA)

- As of March 2, 2000, at 4.00 hours the concentration in Sulina (Danube Delta) was of 0.0094 mg/l compared with 0.01 mg/l (MAC- maximum permissible limit).
- As of March 2, 2000, the Romanian part of the Danube had no concentration for cyan ion over the maximum admissible concentrations.
- On the Romanian part of the Danube there was no observed fish, bird or animal mortality.

4. INTERNATIONAL RESPONSE FOR THE NATECH ACCIDENT

It is important to highlight the following, with view to the international response:

- On February 14, 2000, in Baia Mare, a meeting took place between a delegation from Ministry of Agriculture, Forests, Waters and Environment from Romania led by Mr. Anton Vlad, the Secretary of State, and a delegation from the Hungarian Ministry of the Environment led by Mr. Pal Pepo, the Minister.
- During the meeting at the Commercial Company AURUL SA, the cooperation and and the actions taken by the responsible authorities from both States have been analyzed, starting from the moment the Somes River was accidentally pollution.

- On February 17, 2000, Mrs. Margot Wallstrom, the European Commissioner on Environment Protection Issues, the Romanian Minister of Waters, Forests and Environment Protection and the Hungarian Minister of Environment visited the affected location in Baia Mare. A Task Force led by a nominee representative of the European Union was established in order to:
  - analyse the conditions which led to accidental pollution;
  - assess the damages on the Lapus, Somes, Tisza and Danube aquatic ecosystems;
  - establish the necessary actions to be carried out in order to avoid further accidental pollution.
- Baia Mare Task Force (BMTF) included representatives from the United Nations Environment Program (UNEP), of the Environment Ministries from Romania and Hungary, the E.U, of the International Commission for the Danube River Protection, and also of WWF representatives.
- On this occasion the European Union representative expressed again the availability of EU support for Romania and Hungary in order to mitigate the effects of the accident.
- On February 18, 2000, within the Ministry of Public Works and Territorial Planning, the extraordinary meeting of the Operating Office of the National Commission for the Dams and Other Hydrotechnical Works Safety (CONSIB) took place. During the meeting was analysed the created situation by the technical accident from the Aurul-Bozanta settling pond.
- Also, in the framework of the meeting were analysed the technical aspects of the accident taking into account the first conclusions of the experts commission which preliminary controlled the affected objective and ordered the measures for diminishing the risk of producing a new accident and also for setting the objective into a safety state.
- In the period 26-27 February 2000, an international expert group, under the UNEP, has made a visit in the Baia Mare area, taking samples and discussing, with all the involved factors, concerning the causes and consequences of the accident at SC Aurul SA. At this meeting, local and national officials and civil society representatives have been present.
- During 7 and 8 of March 2000, an European Union international expert group, headed by Mr. Friedemann Allgayer, Director of the Regional General Department of the European Union, visited Baia Mare in order to assess the financial possibilities of the investment projects, within the ISPA structural funds.
- In this respect, the Ministry of Waters, Forests and Environmental Protection proposed the following projects:
  - Built up the Runcu reservoir on the Mara River in order to assure water supply in the town of Baia Mare and surrounding localities;
  - The prevention of accidental pollution on the hydrographic basin Somes-Tisa; monitoring warning alarm system and control sections.

The project proposals have been already agreed by ISPA, taking into account the social impact of the centralized water supply system and accidental pollution prevention in the Somes-Tisa hydrographic basin.

Ministry of Waters, Forests and Environment Protection (MAPAM), is strengthening the control regarding all the similar objectives, and amended the existing regulations, in order to include this type of objectives in the corresponding importance class according to their risk [1]. Also, the National Action Plan for Environment Protection will have in view all the economic objectives that present impact risk in transboundary context. In this purpose, MAPAM try to use with priority part of the technical, economical and financial assistance for these objectives.

5. NATECH RISK ASSESSMENT: STRATEGY OF THE MINISTRY OF WATERS AND ENVIRONMENTAL PROTECTION (MAPAM) TO AVOID NATECH ACCIDENTS

5.1. Measures taken at the national level

Concerning the safety operation of the disposal facilities (Aurul or Novat pond type), MAPAM (Ministry of Agriculture, Forests, Waters and Environment) has promoted a number of legislative acts in order to improve the legal framework for an adequate expertise of the hydrotechnical works, which can pose risk for environment and for human beings. These legal acts are the followings:

- Joint Order of MAPAM and Ministry of Public Works and Territorial Planning for the approval of "The methodology concerning the establishment of the dams importance category" [1];
- Joint Order of MAPAM and Ministry of Public Works and Territorial Planning for the approval of "The methodology concerning the assessment of reservoirs and dams operation safety" [2];
- Joint Order of MAPAM and Ministry of Public Works and Territorial Planning for the approval of "The methodology concerning the assessment of operation safety for dykes from the industrial waste deposits" [3].

A Law concerning dam safety [4] was issued. We have to underline that by dam, all kinds of retaining works are implied, including those carried out for the industrial waste disposal.

- On the basis of this law, the regulations for the issuing of dam and other hydrotechnical works safe operation permits will be updated [5].
- A "Governmental Program of technical expertise of dam safety operation" has been elaborated and on this basis, the settling ponds from the mining, power generation and chemical industry sectors are regularly checked and maintained (Please see Figure B6.d).
- An intensive activity of verification and maintenance of hydrotechnical works was carried out by experts, including mining settling ponds [6].
- The monitoring system will be modernized by adding automatic stations for the continuous surveillance of water quality parameters. These will be located mainly, downstream of pollution sources and upstream of the border of the

transboundary watercourses. Additionally, on the Somes River a complex monitoring program for water quality monitoring was undertaken, including sediments and biota. Guidelines concerning the pollutants effects on environment and the intervention procedures for their mitigation were also elaborated. Furthermore, a complex program for pollution sources control on Tisa and Soma river catchments, was set up.

- A new water supply for the population affected by the Aurul settling pond (Bozanta village) spill was developed, along with the maintenance and improvement of the existing ones.

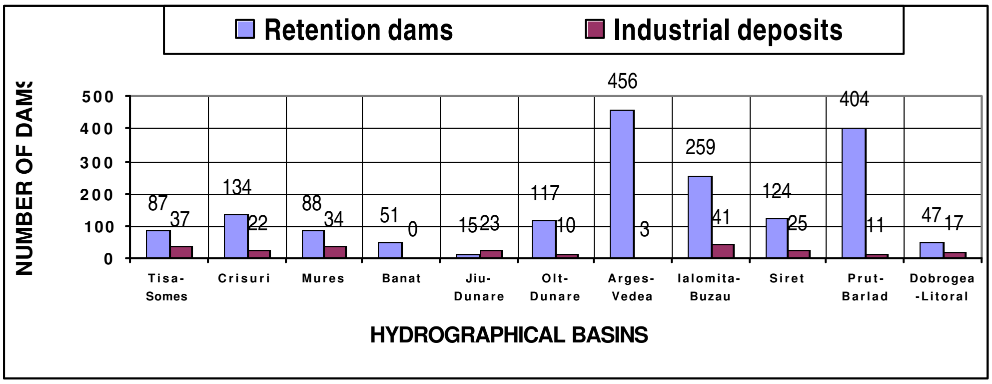


Figure B6.d - Repartition of the industrial deposits and retention dams on hydrographical basins.

5.2. Measures taken at the international level

- A Harmonized Plan of response in case of emergency was elaborated for the rivers of the Upper Tisa basin, together with Hungary and Ukraine. This plan was carried out on the basis of the potential pollution sources inventory (agreed at the trilateral meeting held in Cluj, between 23-24 May, 2000).
- An updated List of the hot spots has been prepared in the framework of Danube pollution Reduction Program. The List of hot spots, very important for transboundary impact, has been prepared and endorsed during a National workshop. The identification has been done in 3 sectors: municipal, agriculture and industry, which are divided into high and medium priority. The List of Hot spots has been reviewed according to the conclusions of the last trilateral meeting held in Cluj (Romania, Hungary, Ukraine).
- Also, as a part of its mandate, the Baia Mare Task Force (the International Task Force for Assessing the Baia Mare accident) was given the task by the European Commission and the Governments of Hungary and Romania of publishing an "Inventory of High Risk Sites" in the mining, extractive and ore-processing industries in the Tisa River basin.
- Carrying out joint harmonized projects with neighbouring countries under international financial assistance.
- Short and long term programs for the safety operation of the potential pollution sources.

REFERENCES

[1] Methodology for establishing the importance categories of dams – NTLH 021, approved through the Order of the Minister of Waters and Environmental Protection and of the Minister of Public Works, Transport and Housing no. 115/288/2002, Official Gazette of Romania;

[2] Methodology regarding the evaluation of secure operation of dams and accumulation lakes - NTLH 022, February 2002, Official Gazette of Romania;

[3] Methodology of evaluating the condition of operational safety of dams and dykes/breakwaters that create deposits of industrial waste – NTLH 023, February 2002, Official Gazette of Romania;

[4] Government Emergency Ordinance no. 244/2000 regarding the safety of dams, approved and modified by the Law no. 466/2001, Official Gazette of Romania;

[5] Order for approving the Procedure and abilities for carrying out the control for the safety of tailing dams operation – NTLH 034, February 2002, Official Gazette of Romania;

[6] The regulations regarding the experts in the evaluation of the secure exploitation of the dams, NTLH 014, NTLH 015, February 2002, Official Gazette of Romania.

B7 – Swedish Natech Activities

Mattias STRÖMGREN
Swedish Rescue Services Agency (SRSA), SE-651 80 Karlstad, SWEDEN
mattias.stromgren@srv.se

Abstract

Up to now Sweden has had very few problems with natech and very few natech incidents. Natural disasters have in general had limited consequences. Sweden has chosen the all-hazard approach and has no specific natech risk management programme. Natech should be integrated into normal risk management work. Swedish risk management programmes are managed at a local level and the municipalities have a responsibility for many aspects of public safety, which includes natech incidents. The companies have responsibilities for the safety within their sites, which also should include natech incidents. Land-use planning and environmental and safety permit granting for establishments are two important strategies for preventing and mitigating natech incidents. Risk mapping is an excellent tool for risk management. It can help in the process of land-use planning and increase awareness and preparedness for natech incidents but also as a tool to take preventive measures. The municipalities are responsible for emergency preparedness and response for almost all emergencies, including natech incidents.

Keywords: Natech; all-hazard approach; risk management at a local level; land use planning; risk mapping; climate changing; environmental impact assessment (EIA); training course, risk and vulnerability analysis, Sweden

1. NATECH RISK MANAGEMENT

In Sweden government authorities cooperate on all risk-related issues. This includes emergency prevention and in some case emergency preparedness and emergency response. Swedish risk management programmes are managed at a local level. Sweden has chosen the “bottom up” approach to insure that all risks are addressed on the basis of the resources that are available. Risk assessment has to be dealt with locally, because emergencies and hazards occur locally. Every emergency/hazard has a geographic position but the effects of the emergency/hazard may be of a local, regional, national or international nature. Therefore, the subsidiary principle is the key factor in Sweden’s risk management policies.

Sweden’s new Civil Protection Act is based on the principle that municipalities have overall responsibility for identifying their risks, taking preventive measures for them, and for producing municipal emergency plans and also emergency response. Different methods are used depending on the type of risks that are to be analysed. The combined risk situation is unique for each municipality. Swedish national agencies provide supervising, tools, support, planning bases and guidance for the municipalities when taking the necessary initiatives for emergency prevention.

1.1 Natural hazards in Sweden

The dominating natural hazards are floods, landslides and snowstorms. Up to now we have had very few problems with earthquakes and tornados. We also have some storms and forest fires but in general they do not do much damage or have much of an affect on society.

Nearly every year some part of Sweden suffers from floods that cause major damage. However, damage can be limited through preventive measures, emergency preparedness and effective operations during serious floods. A tool for this work, General Flood-Risk Maps, highlights the areas under threat during high-water periods and dam breaks.

After the gigantic landslide in Tuve in 1977 – in which 9 people died, 65 houses were destroyed, and 500 people become homeless – politicians and decision-makers began to worry about how many other areas in Sweden were in a similar situation to Tuve; areas that had been built-up without sufficient geo-technical investigation prior to construction. Knowledge on these issues is complicated and may not always be available in municipalities. After the landslide in Tuve, the government decided that there should be a general mapping of municipalities with regard to land-stability in built-up areas. The government also decided to introduce a grant from which municipalities could apply for subsidies to cover the work of preventive measures against landslides and floods in built-up areas.

Every year sees some snowstorms that paralyse large areas of Sweden. They often cause traffic accidents, power cuts, and other disruptions. The railways sometimes experience problems from avalanches.

1.2 Natechs in Sweden

Sweden has relatively minor problems in relation to natechs, and to date we have had very few natech related incidents. The location of industrial facilities running hazardous operations, infrastructure and vulnerable technological establishments and the relatively few natural disasters we have in Sweden have so far not resulted in any severe natech incident. But there are technological establishments that are situated in areas containing natural hazards, so there is potential for natech incidents in Sweden. Because natural disasters in general are rare and Sweden is a large country with very few built-up areas, we could say that natechs are a minor problem for our country. However, there could be future problems because of an increase in major natural hazard incidents due to climate change. It is also important that new technological establishments be situated in safe areas and the necessary prevention and mitigation measures be taken for prevention of existing natech risk.

The natech related incidents that do occur, primarily as a result of floods, mainly affect transportation. It is common for roads and railways to become impassable as a result of heavy cloudbursts and floods. In some cases natural hazards have led to secondary accidents, incidents or disruptions to technical installations. Sometimes there will be disturbances to the electricity supply, phone systems, water supply systems, sewage treatment works, warning, alarming and security systems, and radio and television services.

Sweden has chosen the all-hazard approach and has no specific natech risk management programme. There are no guidelines or legislation specific for managing the risk of technological disasters triggered by natural hazards. However, there are a lot of legislation and guidelines and practical work in progress aimed at reducing risks posed by technological installations and to prevent natural disasters. In addition, the emergency services have resources which are ready to limit the consequences of all emergencies, including natural disasters, which if and when necessary will also reduce natech risks.

2. NATECH PREVENTION AND MITIGATION STRATEGIES

The Swedish strategy for preventing and limiting natech incidents is based on the normal principles for the management of safety in land-use planning and during environmental examinations and supervisions. This means that the national and regional authorities maintain planning data, in the form of risk maps (floods and landslides) and handbooks with recommendations on how to handle risks in community planning and the granting of permits. In addition, there is a national economic subsidy that municipalities can apply for in order to carry out concrete measures to reduce the risk of natural disasters.

Municipalities in Sweden are responsible for carrying out risk inventories within their own borders, for taking preventive measures and establishing emergency plans. This applies to all kinds of emergencies including natural disasters.

2.1 Land-use planning

One of the basic strategies for preventing and mitigating technological emergencies triggered by natural disasters is the issue of location. The municipalities have the overall responsibility for land-use planning. This means that they have the responsibility for knowing about the natural conditions (e.g. areas with poor ground-stability, dams and calculated flood areas) in the municipality and responsibility for the location of new buildings. The construction of vulnerable buildings and technical installations should be avoided in areas that suffer from natural hazards. However, a large proportion of buildings have been constructed before careful consideration was given to the natural risks in the area.

2.2 Environmental and safety examinations for establishments

Safety in technological establishments, including natech safety, is to a great degree the responsibility of the company itself, and of the supervision and permit granting authorities. For example, the permission process for hazardous installations (including Seveso II) and establishments that can affect the environment includes environmental and safety examinations. In these examinations the location and land-use around the site are one important issue. It is also important that ground stability (landslide risk) and the flood risk are taken into consideration during this process.

2.3 Risk mapping

Risk mapping is an excellent tool for risk management. It can help in the process of land-use planning and increase awareness and preparedness for emergencies, but also as a tool to take preventive measures.

The purpose of the general mapping of stability conditions is to provide a map of ground stability in built-up areas. The map should be used as a support for the county administrative boards and the municipalities to indicate where there are areas at risk of landslide. The map shows areas where there is a need for detailed stability investigations or where a review of earlier investigations and measures ought to be made, as they are not in accordance with the recommendations from the Commission on Slope Stability. The result of the mapping is reported to the county administrative board and to the municipalities as part of the ordinary risk management work. Mapping is carried out in two stages. Stage 1a includes the mapping of soil type conditions and topographic conditions. Stage 1b includes an assessment of stability for existing conditions.

The SRSA is responsible for producing General Flood-Risk Maps in Sweden. Hydrological consultants who are commissioned by the SRSA produce the maps. The General Flood-Risk Maps are submitted to the county administrative boards and the municipalities along the waterways as basic information for land-use planning. Currently, there are no plans to update the general maps, because there is a long list of rivers that have yet to be mapped at all. The county administrative boards and the municipalities must take into consideration that the databases are general and that they should provide more detailed information for the general maps when and as it becomes available.

Waterway maps (see Figure B7.a) highlight the areas that are at risk from flooding during two known high water discharges.

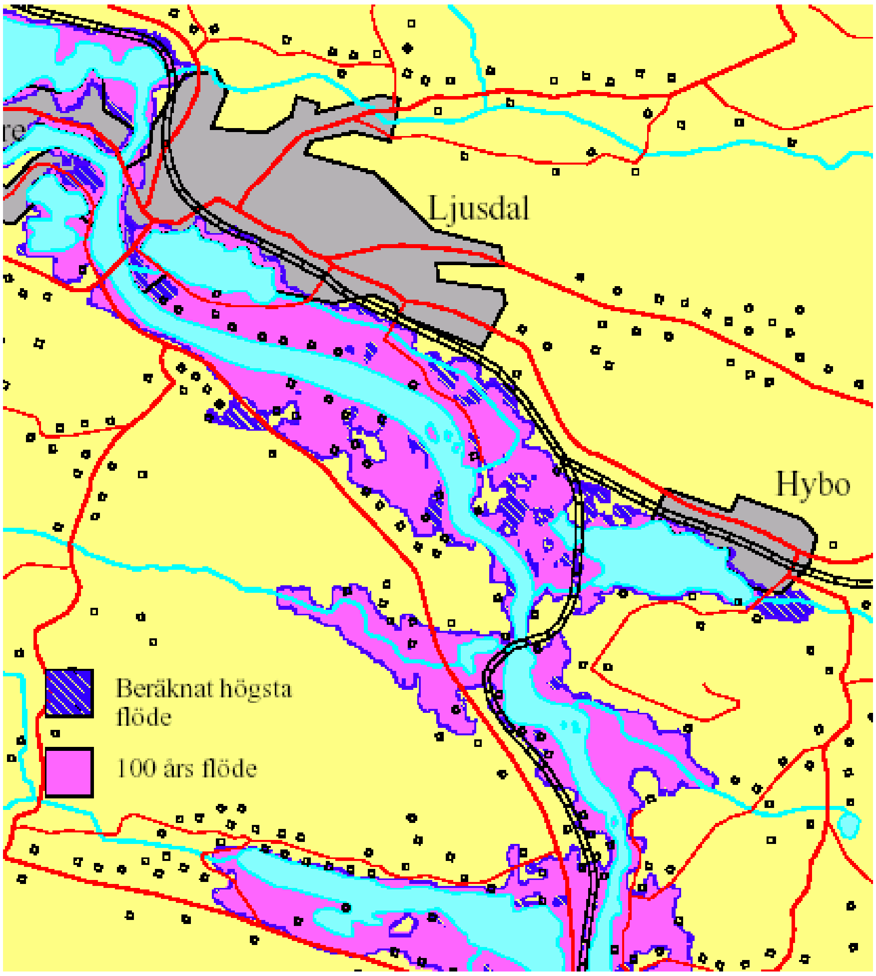


Figure B7.a – Example of a waterway map in Sweden.

The 100-year flood, returns every 100 years. The second flood, called the highest estimated flood, is calculated in accordance with the Swedish Flood Committee's guidelines for the dimensioning of dams (dams in risk class I). The calculation is made on a systematic combination of all the critical factors (rain, melting of snow, high ground moisture, and the filling of basins in governed waterways) that contribute to a flood.

2.4 Government subsidies for preventing natural hazards

The municipalities work systematically with the areas pointed out in the general stability maps and general flood-risk maps. They carry out detailed investigations to define how large the problem is. When the problem is defined and preventive measures are suggested the municipality can apply for a subsidy to pay for the preventive measures. The SRSA administrates these subsidies, assisted by the Swedish Geotechnical Institute and the Swedish Meteorological and Hydrological Institute, who participate in the technical investigation of the subsidy application. A great number of preventive measures are taken in built-up areas every year as a result of the mapping and the possibility to apply for subsidies.

2.5 Environmental Impact Assessment (EIA)

Environmental impact assessments (EIAs) are mandatory in the environmental permit granting process, in infrastructure planning and in some other areas of land-use planning referred to in the EIA directive (85/337/EEG, 97/11/EG). Safety is an important part of the EIA.

The risks that are to be dealt with in the EIA are all emergency risks that are relevant for each specific project or establishment. It can be risks that affect the surrounding area (e.g. release of dangerous substances from a chemical site). It can also be risks that present hazards for technical installations and other activities (e.g. risk for flooding, which can have a domino effect by starting another incident, or where the overflowing water becomes contaminated by dangerous substances and spreads to sensitive natural areas and water supply sources).

Various factors in our surroundings that influence safety and external conditions for emergency operations should be described in the EIA. It can include, for example, emergency planning, rescue equipment, response times, accessibility for emergency vehicles and other facilities for emergency operations.

The goal for safety descriptions in the EIA is to provide a comprehensive picture of safety, with regard to human health and environmental care. It is important that all safety aspects are treated in the same way and also integrated with other issues in the EIA. A handbook issued by the Swedish Rescue Services Agency (SRSA) presents a general method for integrating risk management into the EIA process.

2.6 GIS tools for Swedish municipalities, called RISK-ERA

The SRSA has developed a mini GIS system, called RISK-ERA, designed for use by any of the municipalities for the purpose of risk management. The system has been developed hand in hand with representatives from the municipalities so that their requirements could be incorporated. Using Risk-Era the municipalities can complete and revise an inventory of various types of risks. They can also generate emergency scenarios for sources of on-site risks. Risk analysis implies setting the level for probability and consequence and weighing all risks against each other in order to prioritise emergency prevention work.

2.7 Climate change

Natechs can be a large problem in the future if we don't take into account the consequences that climate changes can bring about. Future incidents in a changed climate could for example be:

- A greater risk of dams breaks;
- More floods and landslides (in summer and autumn);
- More forest fires;
- A greater risk of avalanches;
- Incidents due to hard winds;
- More house fires – due to lightning and thunder storms.

3. NATECH PREPAREDNESS STRATEGIES

There are no specific natech preparedness strategies in Sweden. The preparedness strategies instead, cover among other things, natural hazards (especially floods), house fires, chemical emergencies and rail and road traffic accidents.

Society needs the capacity that allows it to take action in emergencies to mitigate the consequences of extreme weather phenomena. We cannot stop rain, snow or landslides but we can reduce the threat they pose. We believe that preparedness, preparation and more precise weather forecasting are important. Strong winds, storms and hurricanes, heavy rain, snow, ice and salt coating are the factors that cause most damage to infrastructures. Weather of this kind often strikes large regions causing a number of incidents simultaneously.

3.1 New Training in emergency prevention and mitigation

Sweden has a brand new two-year training course in emergency prevention and mitigation. One of the goals for this training is to meet the needs from the municipalities regarding emergency response and stronger emergency prevention. This training deals much more with preventing and mitigating natural hazards than the old 15-week course in firefighting and rescue did. The new training also covers society's vulnerability and the consequences of disruptions to important technical supplies.

3.2 National flood mitigation resources

At present the SRSA has the commission from the government to build up national flood mitigation resources into four regional supply depots. These resources include mobile water barriers, and can be available within 24 hours for use by the municipalities in the event of widespread floods.

3.3 Crisis management

A new law states that all municipalities have to be prepared for crises and emergencies. The municipalities are obliged to carry out risk and vulnerability analyses at a local level. The risk and vulnerability analyses should include natech. The county administrative boards should support the municipalities in their crisis management work. One of the purposes of this is to strengthen society's ability to deal with crises and emergencies.

3.4 NATECH RESPONSE AND RECOVERY STRATEGIES

In the event of emergencies the municipalities are responsible for emergency response. When emergencies occur municipal fire and rescue services carry out emergency operations. For some incidents the municipality coordinates and supervise the mitigation and recovery work. Every municipality has a municipal emergency command board.

If the event affects a large part of society or if it escalates, the municipality can increase the level of alert. The county administrative board supports the municipalities in certain incidents.

3.5 LESSONS LEARNT

It is difficult to communicate lessons learnt about natech incidents if no natech incidents occur. Sweden has that problem and we think it is a good problem. The SRSA searched for natech incidents in Sweden and found nothing to report. Of course there have been a number of natural disasters in Sweden over the last hundred years, but they were usually contained to the initial incident and did not cause secondary technological incidents. Some examples are:

- A landslide triggering a train derailment (Getå 1918). (This is probably the only "genuine" natech event in Sweden. A landslide destroyed the railway bank and a train with about 300 passengers derailed and went into the cavity. At least 41 people were killed),
- A flood triggering the leakage of mercury from polluted soil (Bengtsfors 2000),
- A flood which led to a polluted drinking water source and a disruption to the water supply (Norrland 2000),
- A flood triggering a train accident (Norrland 2000),
- A mud avalanche triggering a train derailment.

Section C:
COUNTRY PRESENTATIONS

C1 – Flood Disasters in the Pre-Alpine Area of Corinthia

Reinhold DORFLINGER
Amt der Kärntner Landesregierung
Arnulfplatz 1,A - 9020 Klagenfurt, AUSTRIA
reinhold.doerflinger@ktn.gv.at

28.8. 2003 Biskaya - Tief
29.8. 2003 Labilisierung zu den Alpen
30.8. 2003 Tief über Norditalien und im Grenzbereich „Vorderberg"
31.8. 2003 Abzug des Tief's

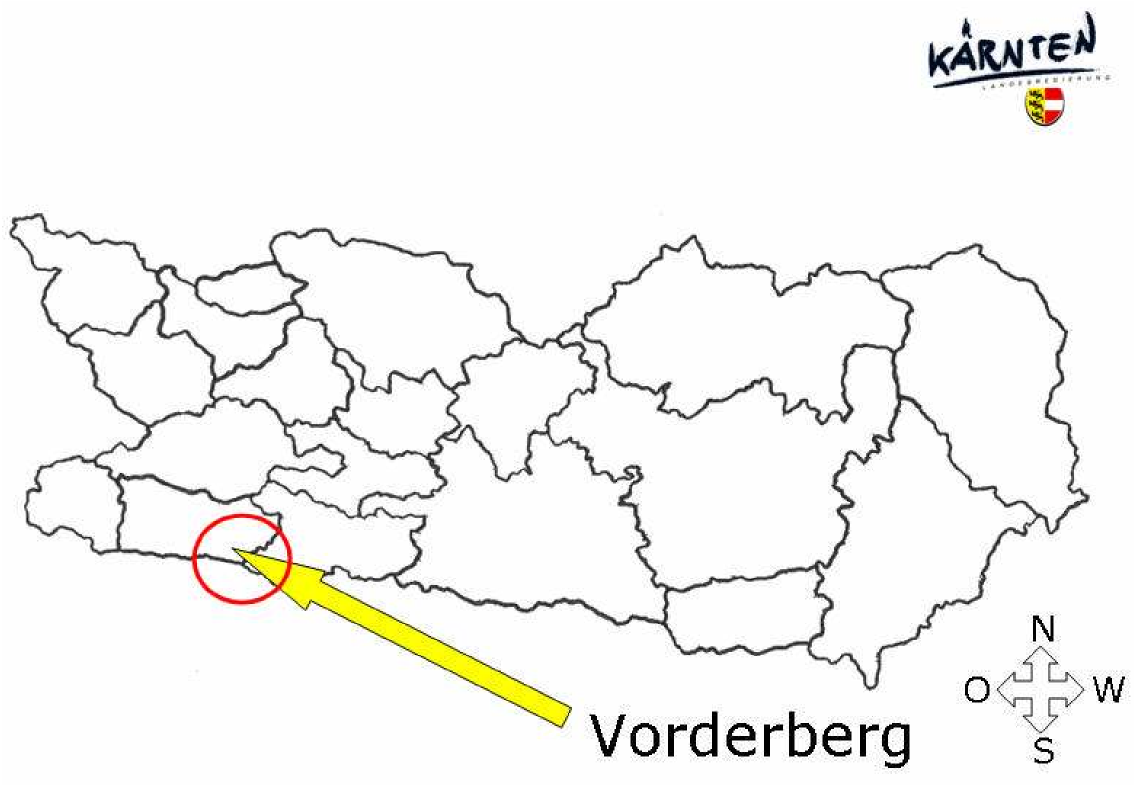
28.8. 2003 Low pressure area over the Gulf of Biskaya
29.8. 2003 Air masses become unstable towards the Alps
30.8. 2003 Low pressure area over Northern Italy and the border area with Austria - „Vorderberg"
31.8. 2003 Low pressure system leaves the area

Prognose:

27.8. 2003 11.00 Uhr: 24 °C – 29 °C
auf 2000m 14 °C
28.8. 2003 VORMITTAG - schön
NACHMITTAG - Quellbewölkung mit Regen
Höchstwerte bis 30 °C
NACHT - stärkerer Regen im Gailtal
29.8. 2003 Intensive Niederschläge
30.8. 2003 Am Abend Nachlassen der Niederschläge

Forecast:

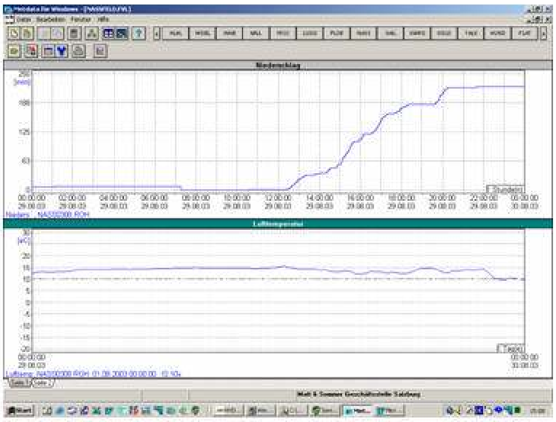
27.8. 2003 11.00h: 24 °C – 29 °C
at 2000m elevation: 14 °C
28.8. 2003 morning to midday – fine (fair)
afternoon - Cumulus cloud formation, rain
Maximum temperatures up to 30 °C
night - Higher intensity precipitation in the Gailtal
29.8. 2003 High intensity precipitation
30.8. 2003 In the evening abatement/decrease of precipitation


Vorderberg
N
O
W
S

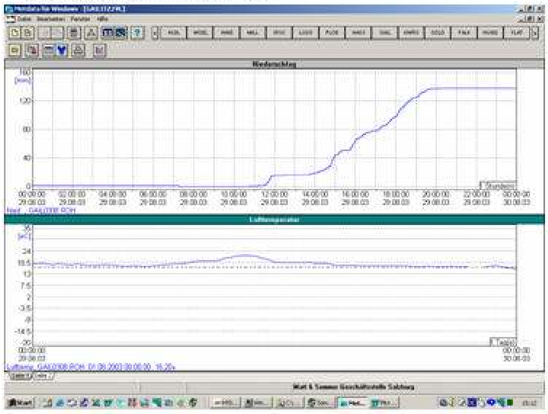

Einzugsgebiet
Catchment area
ArcView GIS 3.2
26,9 km2

Niederschlag am 29.08.2003
Rain on 29.08.2003

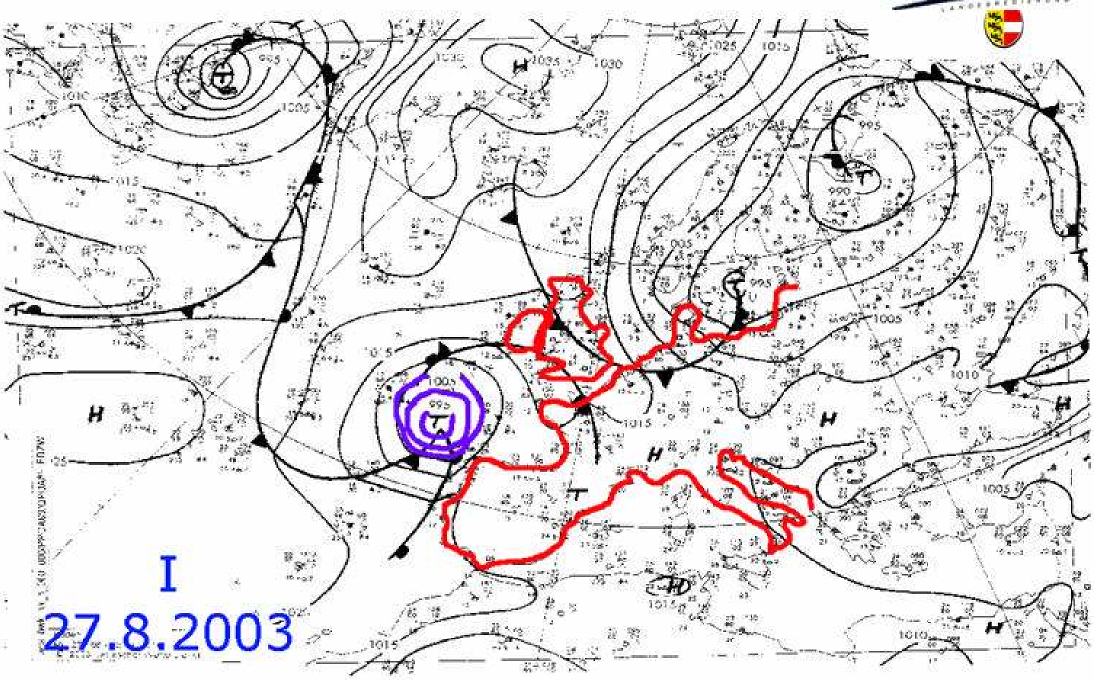
Station Naßfeld
Meteorological Station Naßfeld



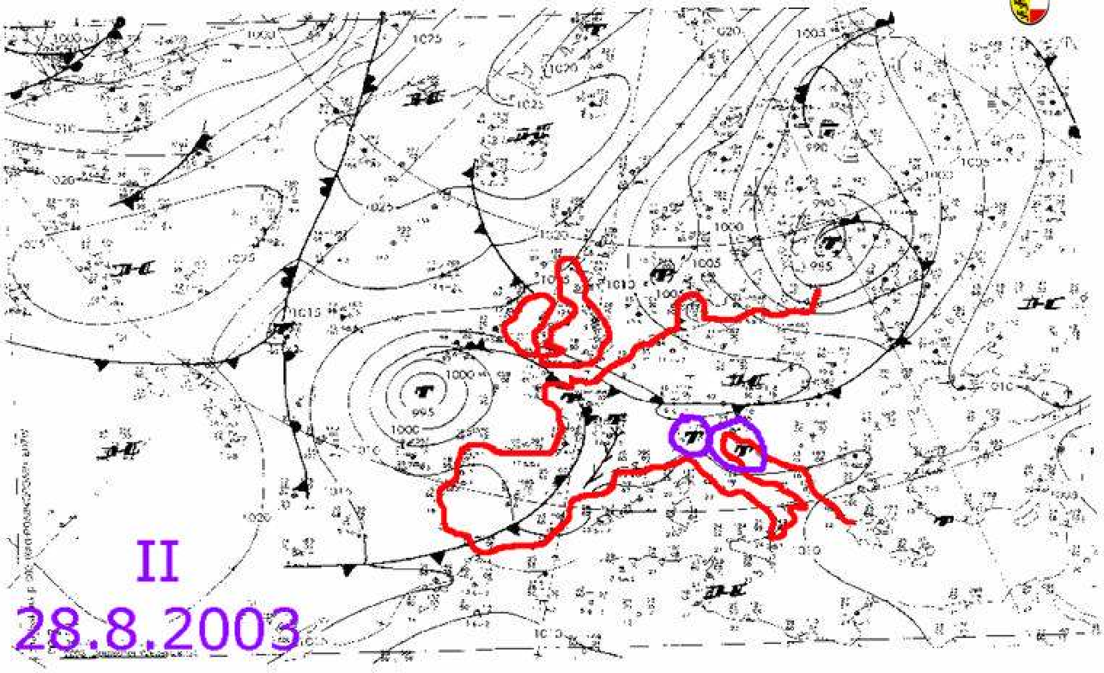
Station Gailitz/Arnoldstein
Meteorological Station Gailitz/Arnoldstein



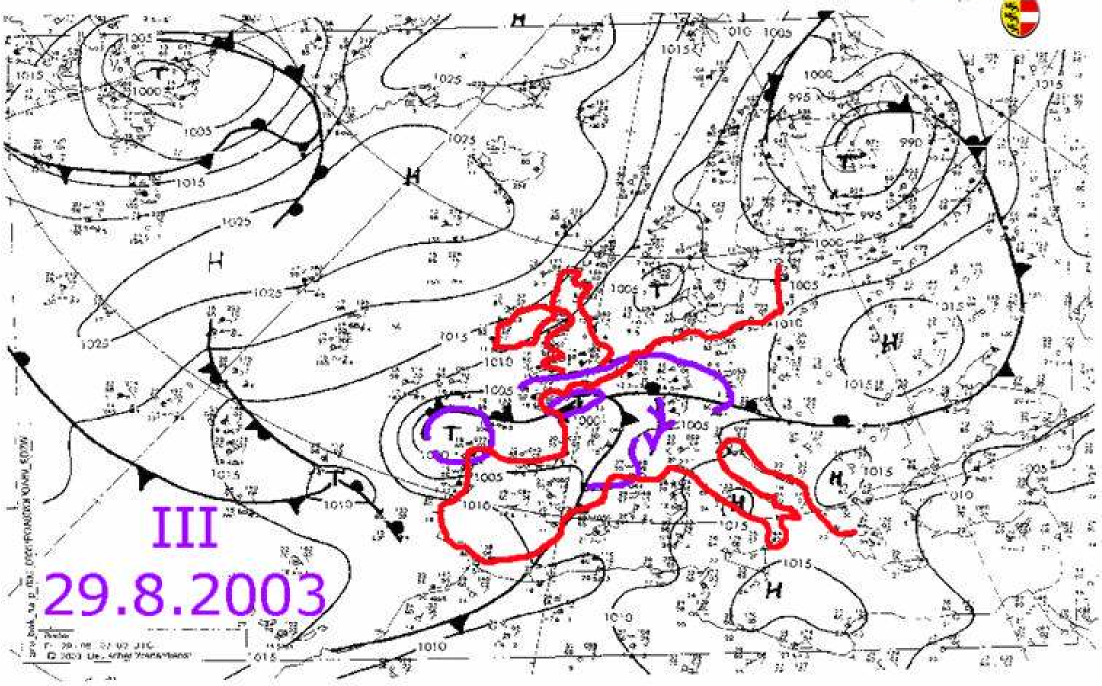
Tiefdruckgebiete – Low pressure areas

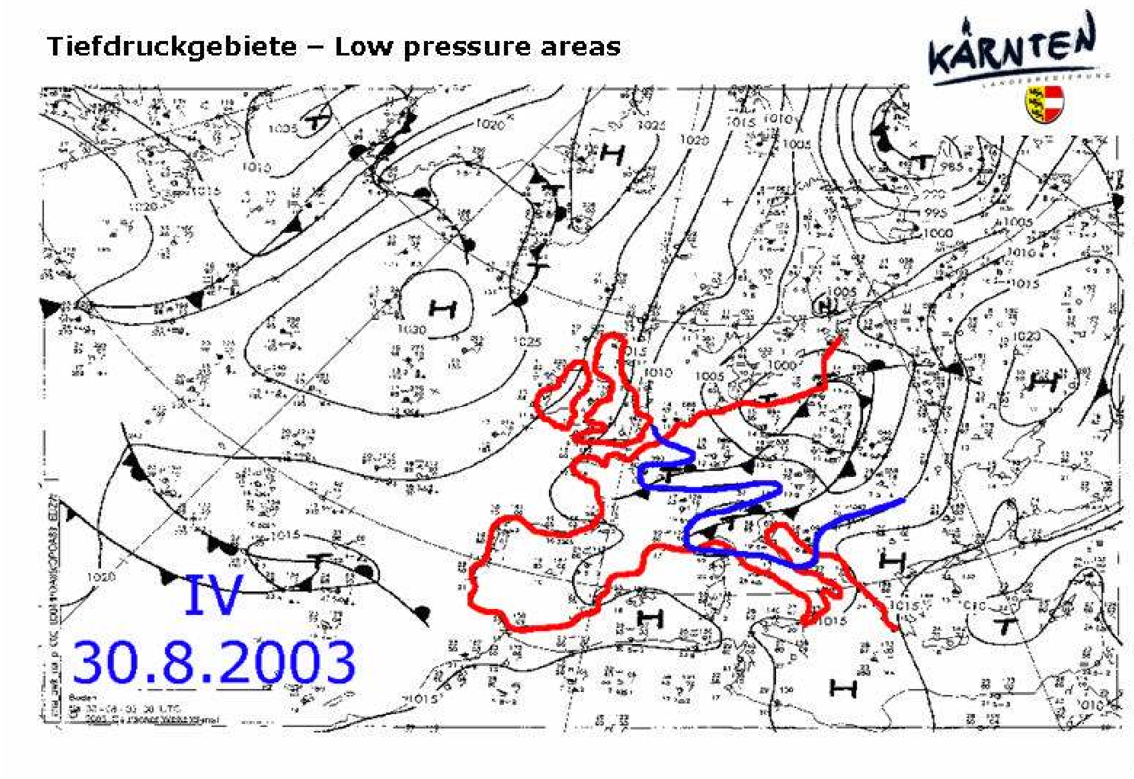


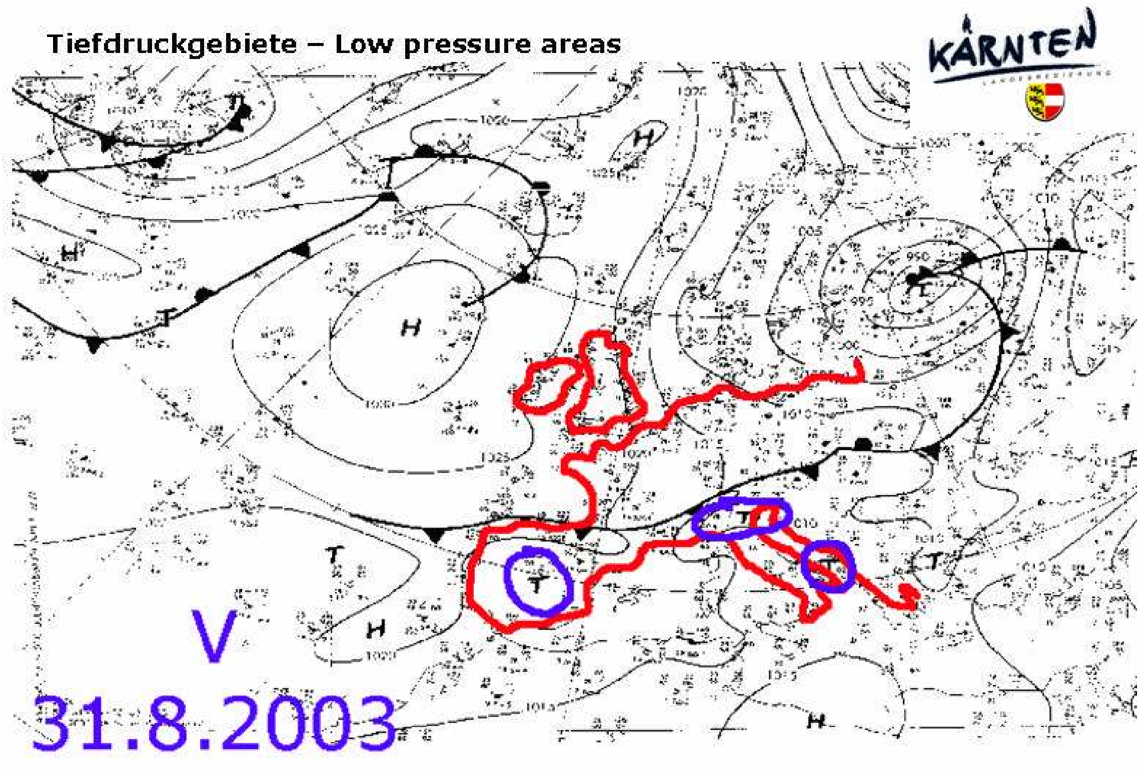
Tiefdruckgebiete – Low pressure areas



Tiefdruckgebiete – Low pressure areas




Tiefdruckgebiete – Low pressure areas
KÄRNTEN
IV
30.8.2003


Tiefdruckgebiete – Low pressure areas
KÄRNTEN
V
31.8.2003

Niederschlagsmengen:

29.8. 2003	VILLACH	100 mm/m²
30.8. 2003	VORDERBERG	~ 150 mm/m² *
31.8. 2003	UGGOWITZ	~ 400 mm/m² *

* Keine Messstationen vorhanden (Annahme)

29.8. 2003	FEISTRITZ/GAIL	112 mm/m²
30.8. 2003	FEISTRITZ/GAIL	265 mm/m²
31.8. 2003	FEISTRITZ/GAIL	370 mm/m²

Ursache:
a) extremer Südstau
b) lang anhaltende Gewittertätigkeit in der hochreichend feuchtlabil geschichteten Luft

Precipitation amounts:

29.8. 2003	*VILLACH*	*100 mm*
30.8. 2003	*VORDERBERG*	*~ 150 mm **
31.8. 2003	*UGGOWITZ*	*~ 400 mm **

** Esimated value (No raingauge in the area)*

29.8. 2003	*FEISTRITZ/GAIL*	*112 mm*
30.8. 2003	*FEISTRITZ/GAIL*	*265 mm*
31.8. 2003	*FEISTRITZ/GAIL*	*370 mm*

Cause of high precipitation amounts:
a) Extreme event of air masses piling up against southern (mountain) slopes
b) Long lasting thunderstorm activity in the atmosphere, which had a humid-unstable stratification up to high altitudes


KÄRNTEN


KÄRNTEN


KÄRNTEN


KÄRNTEN


KÄRNTEN


KATASTROPHENHILFSDIENST
TRINKWASSERAUFBEREITUNGSANLAGE
KÄRNTEN

Vielen Dank für Ihre Aufmerksamkeit !

Thank's for your attention!

C2 – Natural and Technological Risk Management in Cyprus

Panayiotis Michael KATSOURAS
Civil Defence, 63 Pericleous Street
PO Box 23830, 1686 Nicosia, CYPRUS
ge.cd@cytanet.com.cy

NATECH RISK ASSESEMENT

- FACING NATECH RISK
- PROVIDED BY 2001 REGULATIONS
- CABINET DECISION/LAW 227/90
- IMPLIMENTATION OF THE LAW IN CASE OF ACCIDENT
- SEA POLLUTION
- POLLUTION OF SOIL
- ATMOSPHERE POLLUTION BY EXPLOSIVE MIXTURE
- GROUND WATER POLLUTION

Recent exercises at the crude oil storage tank

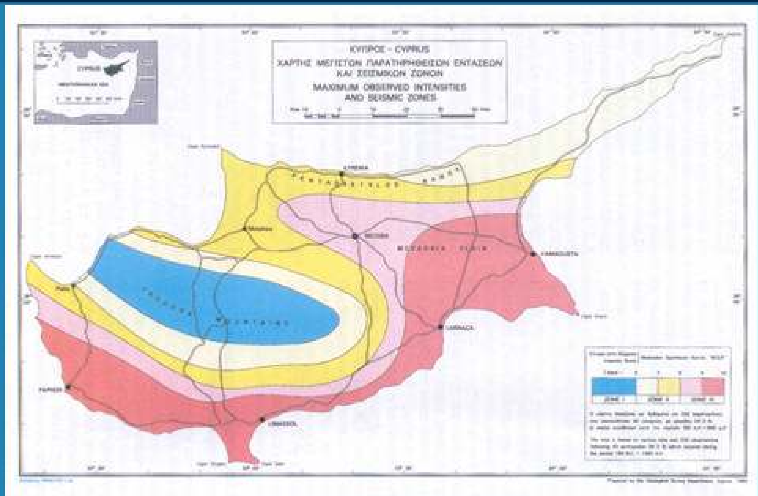
4

IN CASE OF EARTHQUAKE

- LOCATION: LARNACA
- PETROLEUM TANK: T-3004 CYPRUS PETROLEUM REFINERY
- DIAMETER 61M HEIGHT, 20 M WIDTH
- CRUDE OIL STORAGE TANK
- CONTENT 44000 METRIC TONS CRUDE OIL
- LARNACA'S VULNERABLE HAZARDOUS INSTALLATIONS
  - PETROLEUM REFINERY
  - WATER REFINERY
  - DEKELIA ELECTRIC TOWER STATION

5

CYPRUS MAP OF SISMIC ZONES



Σχήμα VIII - 4. Χάρτης Σεισμικών Ζωνών της Κύπρου.

6

NATECH PREVENTION AND MIDIGATION STRATEGIES IN CASE OF EARTHQUAKE

- **RUPTURE OF PIPES OF THE CRUDE OIL STORAGE TANK RUPTURE OF THE CRUDE OIL BANDWALL**
- **CONSEQUENCES OF THE RUPTURE OF THE CRUDE BANDWALL:**
  - SEA POLLUTION
  - POLLUTION OF SOIL
  - ATMOSPHERE POLLUTION BY EXPLOSIVE GASES
  - GROUND WATER POLLUTION

7

MITIGATION MEASURES

- SECLUSION MEASURES
- REFINERY FIRE BRIGADE INTERVENTION
- REFINERY EMERGENCY CONTROL ROOM
- OIL RESPONSE GROUP SPILLAGE

8

NATECH PREPARADNESS STRATEGIES

- FIRE PUMPS
- FIRE BRIGADE EQUIPMENT
- FIRE TRUCKS
- FIRE TENDER

9

IN CASE OF SPILLAGE

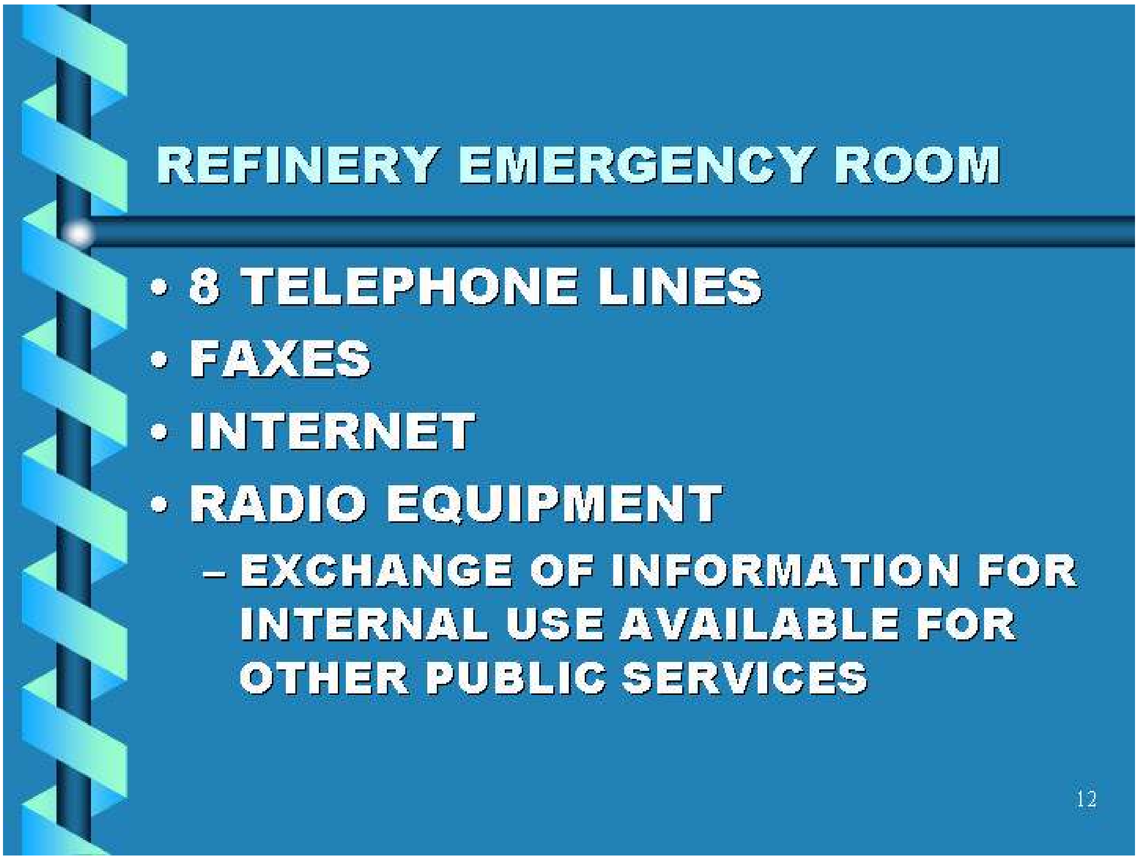
- OIL RESPONSE GROUP SPILLAGE
- OIL SPILLAGE RESPONSE VESEL
- OIL SPILLAGE RESPONSE EQUIPEMENT
- FIRE SPECIALIZED TRAINING IN CYPRUS AND ABROAD
- OIL SPECIALIZED TRAINING IN CYPRUS AND ABROAD

10

WARNING SYSTEM

- REFINERY WARNING SYSTEM
- CIVIL DEFENCE SIREN'S SYSTEM
- CIVIL DEFENCE PUBLIC AWARENESS WITH BROCHURES
- RADIO AND T.V.

11

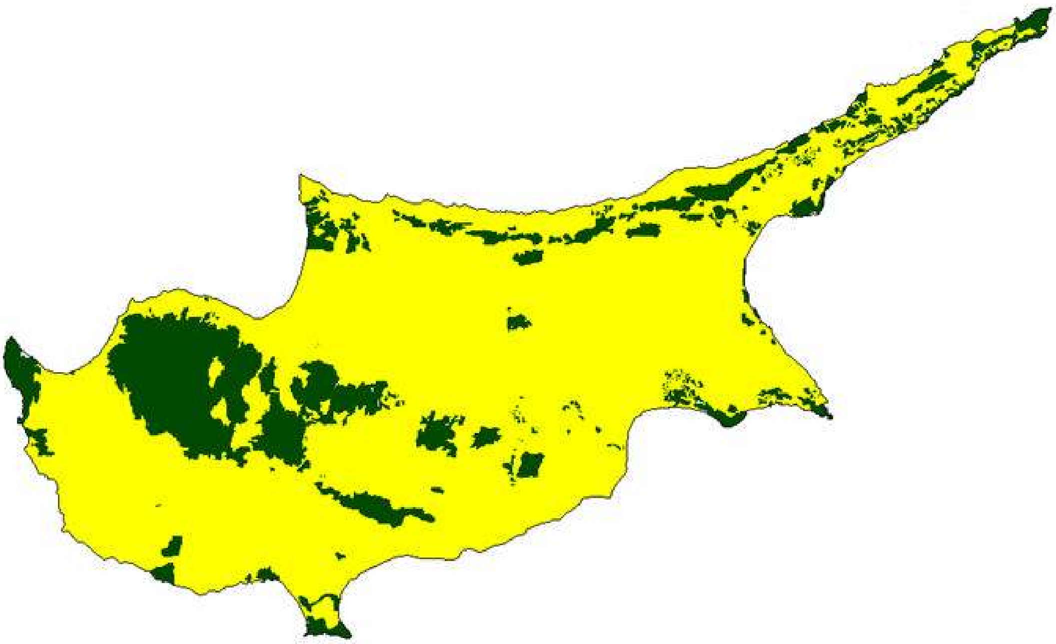

REFINERY EMERGENCY ROOM
• 8 TELEPHONE LINES
• FAXES
• INTERNET
• RADIO EQUIPMENT
– EXCHANGE OF INFORMATION FOR INTERNAL USE AVAILABLE FOR OTHER PUBLIC SERVICES
12


NATECH RESPONSE AND RECOVERY STRATEGIES
• MARKETER PETROLEUM COMPANIES
• CIVIL DEFENCE EMERGENCY SCHEME, LAW1996& 1998
• SERVICES INVOLVED
– THE DISTRICT OFFICER
– THE CIVIL DEFENCE
– THE FIRE SERVICE
– THE POLICE
– THE PUBLIC WORKS DEPARTMENT
– THE HOSPITAL
– THE ELECTRO-MECHANICAL SERVICES
– THE TELECOMUNICATIONS
13

IN CYPRUS

- NO FLOOD TRIGGERING INDUSTRIAL ACCIDENT
- NO EARTHQUAKE TRIGGERING INDUSTRIAL ACCIDENT
- NO FOREST FIRE TRIGGERING INDUSTRIAL ACCIDENT
- NO STORM TRIGGERING DAM OVERTOPPING TRIGGERING FLLOD

14

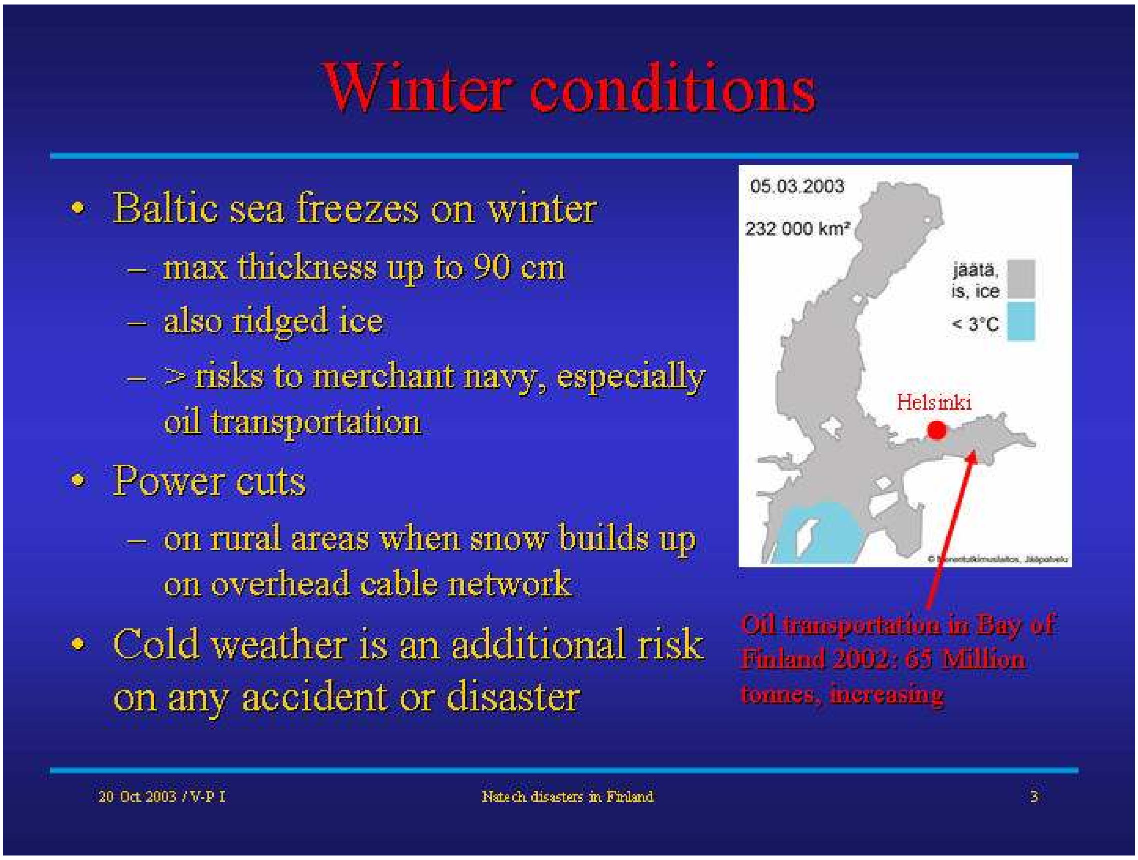



IN CYPRUS NEVER
HAPPENED SIGNIFIGANT
NATECH EVENT
16

C3 – Natech Disasters in Finland: Are There Any?

Veli-Pekka IHAMAKI
Depart. For Rescue Services, Ministry of Interior
Kirkkokatu 12, 00023 Helsinki, FINLAND
veli-pekka.ihamaki@intermin.fi


Natural disasters in Finland?
No vulcanos
No tornados
No landslides
No tsunamis
No big avalances
Norway
Russia
Sweden
Finland: sparsely inhabited flat country with forests and lakes
Helsinki
Estonia
Floods: spring floods annually, big floods seldom
Severe winters: cold, ice, snow
Forest fires: small, average size < 0,3 hectares
10 – 15 Earthquakes annually, all < 4 Richter
Strong winds
MAGNITUDI
1965-1998


Winter conditions
• Baltic sea freezes on winter
– max thickness up to 90 cm
– also ridged ice
– > risks to merchant navy, especially oil transportation
• Power cuts
– on rural areas when snow builds up on overhead cable network
• Cold weather is an additional risk on any accident or disaster
05.03.2003
232 000 km²
jäätä, is, ice
< 3°C
Helsinki
Oil transportation in Bay of Finland 2002: 65 Million tonnes, increasing
20 Oct 2003 / V-P I
Natech disasters in Finland
3

Prevention and mitigation strategies

- Building and land-use standards and legislation
  - Land use act: When assessing the construction site's suitability for building, the risks of flooding, landslides and avalanches must always be considered
  - Strength requirements on structures for snow and wind load
  - Storage of chemicals & oil products
  - Eurocode pre-standards in national documents (NAD): strength requirements in cases of loads from collisions and explosions.
  - International legislation and EU directives
  - oil transportation on double-bottom ships
  - legal acts against bilge wastewater pumping to sea
- Funding: oil protection fund
- Other arrangements
  - Maritime: Gulf of Finland Vessel Traffic Monitoring and Information System (VTMIS), Automatic Identification System (AIS)

20 Oct 2003 / V-P I — Natech disasters in Finland — 4

Preparedness Strategies

- Strategy: Natech preparedness is a part of overall preparedness
- Monitoring: Finnish meteorological institute, Environment authorities, forest fires (airplanes, satellites)
- Alerting population
  - Siren network (under process of updating)
  - National radio and TV broadcasting company: override to all radio broadcasts
- Fire and Rescue Services: rescue services preparedness
- National Preparedness Act: all authorities and enterprises are responsible for preparedness measures in their field
- Oil spills preparedness: vessels, material

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C4 – Preparations to cope with Natech Disasters in Hungary

Zoltan CSÉPLO
National Directorate General for Disaster Management
Mogyoródi út 43, 1149 Budapest, HUNGARY
zoltan.cseplo@katved.hu

Antecedents

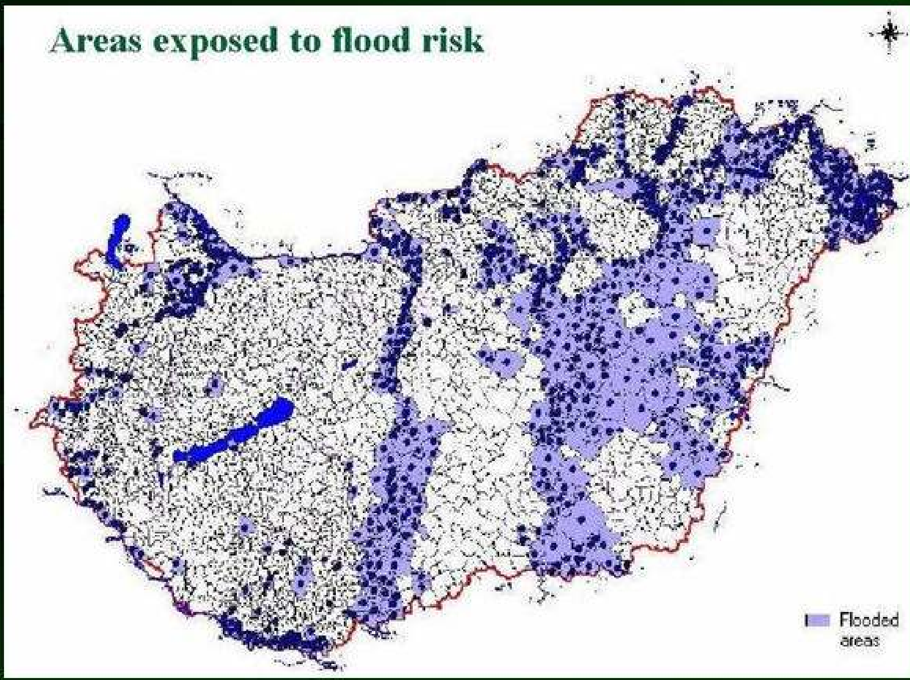
Following Hungary' s accession to NATO, in light of the recent crisis in Kosovo, the significance of security, including civil emergency planning, civil protection, disaster relief and crisis management, has increased.

Preparations for Natural Hazards Triggering Technological Disasters in Hungary

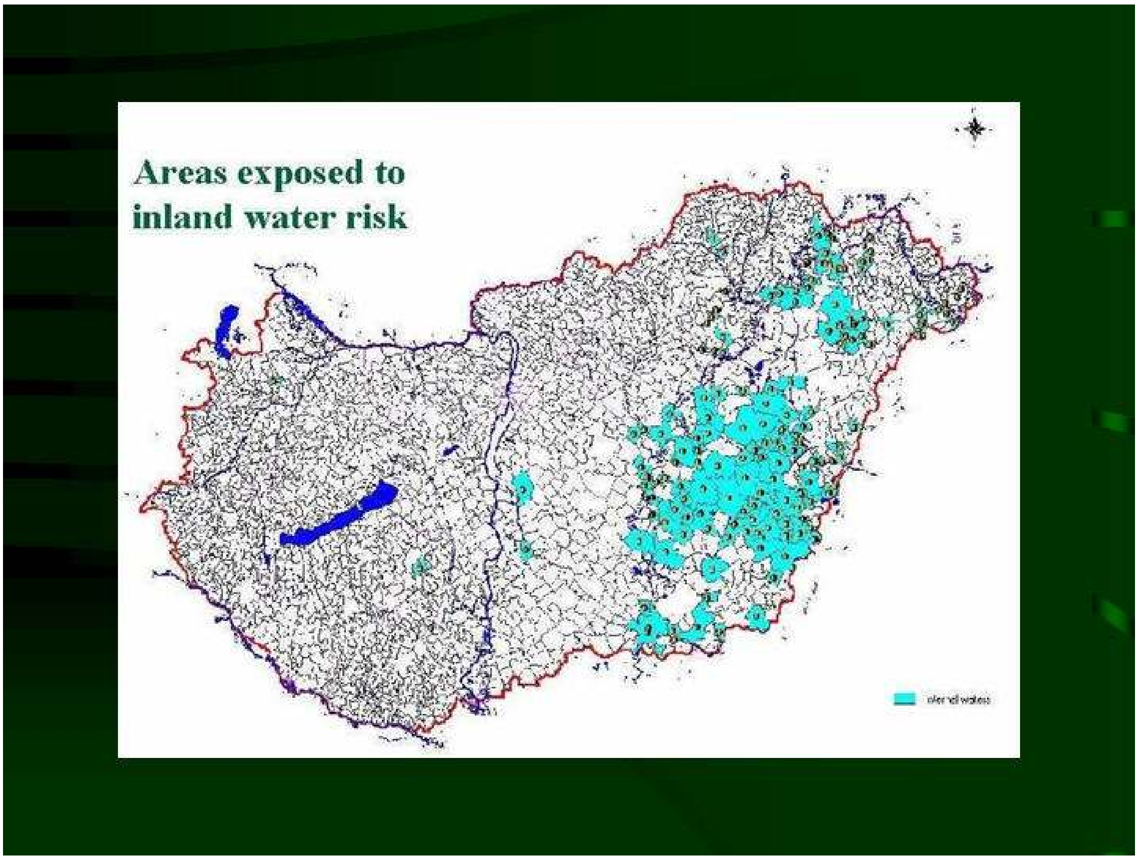
By virtue of authorisation as under Act XXXVII of 1996 on civil defence the Ministry of Interior Decree No. 20/1998 (IV. 10.) on the system and requirements of civil protection planning has been issued in the Republic of Hungary, which ordered the establishment of a complex system of plans for eliminating danger.

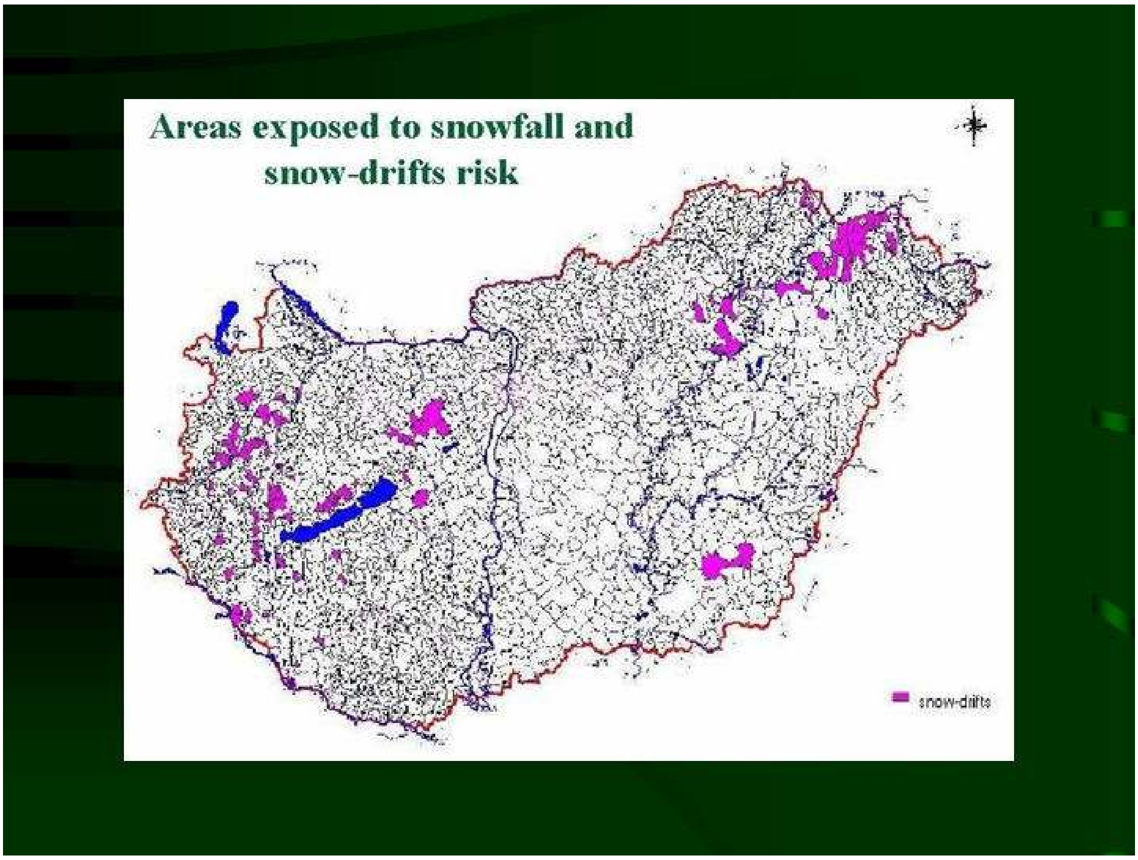
- The factories that had been classified as dangerous factories.
- The following danger effects:
  - floods
  - inland waters
  - water pollution
  - extremely weather conditions
  - earthquake, landslide
  - air pollution
  - production, use and storage of dangerous substances

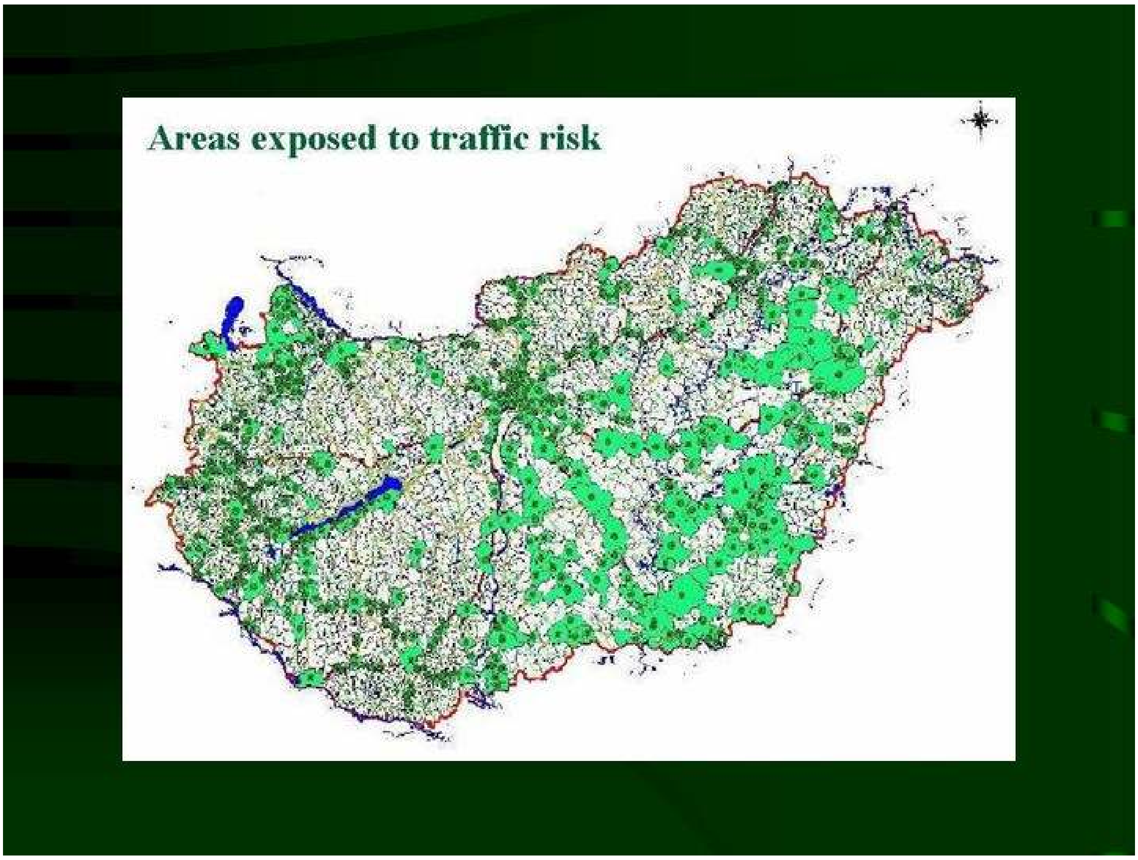
  - transport of dangerous substances
  - effects of dangerous waste
  - explosion in the plant, residential area
  - fire
  - interruption of utilities
  - typical movement of crowd
  - epidemic
  - nuclear danger

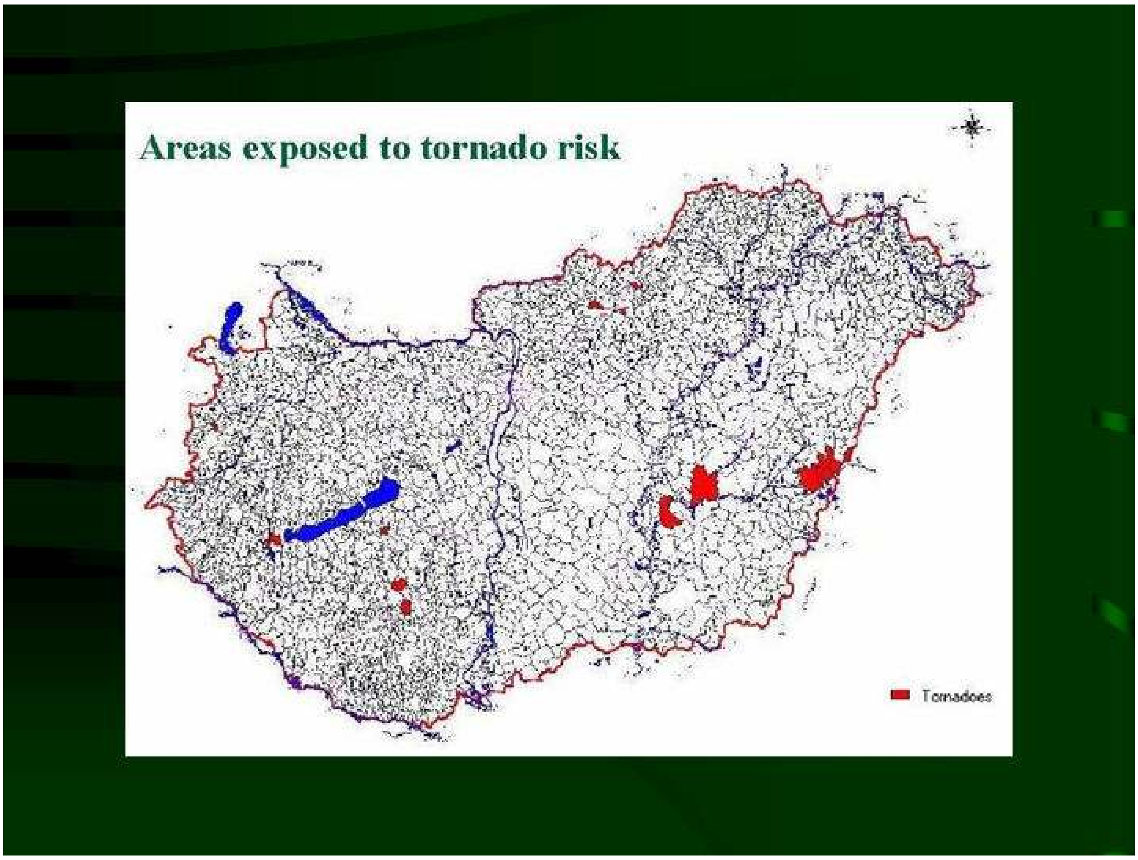


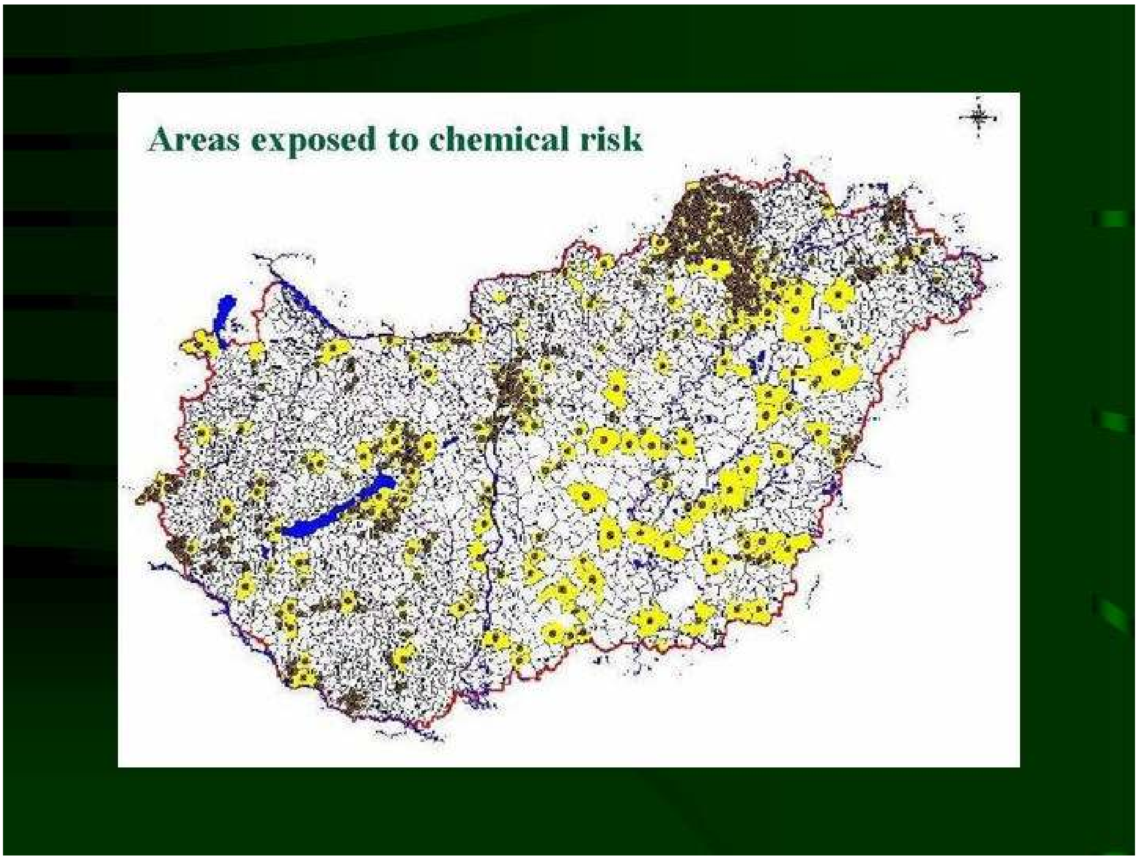
Maps of the exposed areas to risk in Hungary

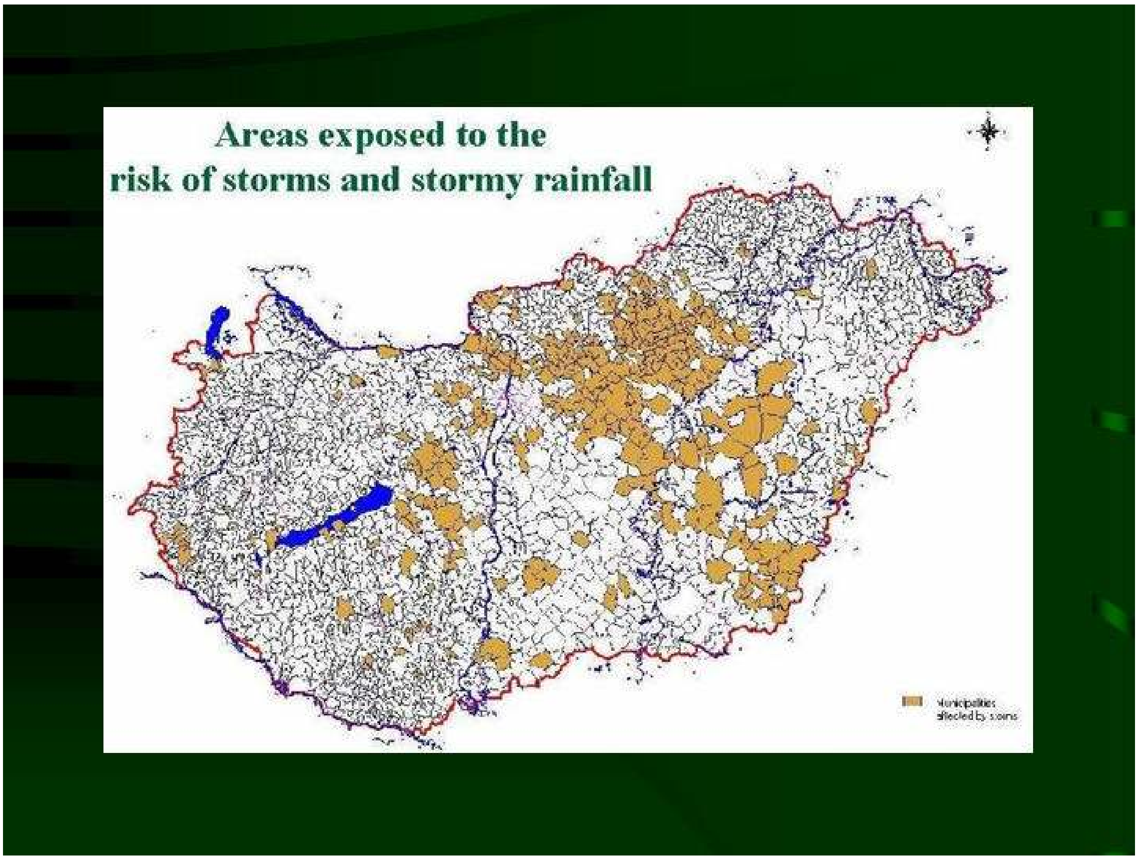

Areas exposed to
inland water risk


Areas exposed to snowfall and
snow-drifts risk
snow-drifts

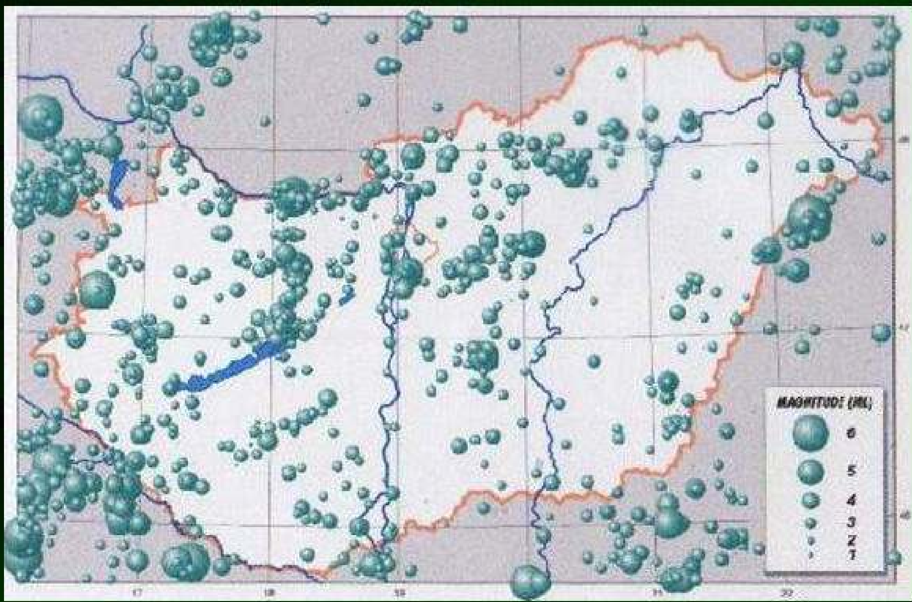

Areas exposed to traffic risk


Areas exposed to tornado risk
Tornadoes


Areas exposed to chemical risk


Areas exposed to the
risk of storms and stormy rainfall

Earthquakes in Hungary



- This classification has been carried out in accordance with the provisions of the Government Decree No. 114/1995 (IX. 27.) on the regulations on classifying settlements with regard to civil defence and defence requirements.

Provisions of law determining the establishment of state of emergency plans:

- Act XXXVII. of 1996 on civil defence;
- Government Decree No. 114/1995 (IX. 27.) on the regulations on classifying settlements with regard to civil defence and defence requirements;
- Government Decree No. 196/1996 (XII. 22.) on the regulations on participation in rescue operations, on the sphere of authority of the competent civil defence authority and the civil defence tasks of ministers;

- Government Decree Decree No. 60/1997 (IV. 18.) on the general regulations on public shelter protection, supply of individual protection equipment, alerting the public, relocation and sheltering;
- Ministry of Interior Decree No. 55/1997 (X. 21.) on establishing civil defence organisations based on civil defence obligation, their management, financial-technical supplies, and application;
- Ministry of Interior Decree No. 13/1998 (III. 6.) on the requirements of civil defence training;
- Ministry of Interior Decree No. 20/1998 (IV. 10.) on the system and requirements of civil defence planning.


Thank you for your attention !

C5 – Natural and Technological Disasters Risk Management in Lithuania

Zoltan CSÉPLO
Civil Protection Department, Ministry of National Defence
Pamenkalnio str. 30, 2600 Vilnius, LITHUANIA
petras.voveris@csd.lt

- System, structure and strategy of activities of Lithuanian civil protection are predetermined by specific living conditions and are influenced by the sources of emergency situations that exist in our country

The main natural and technological hazards

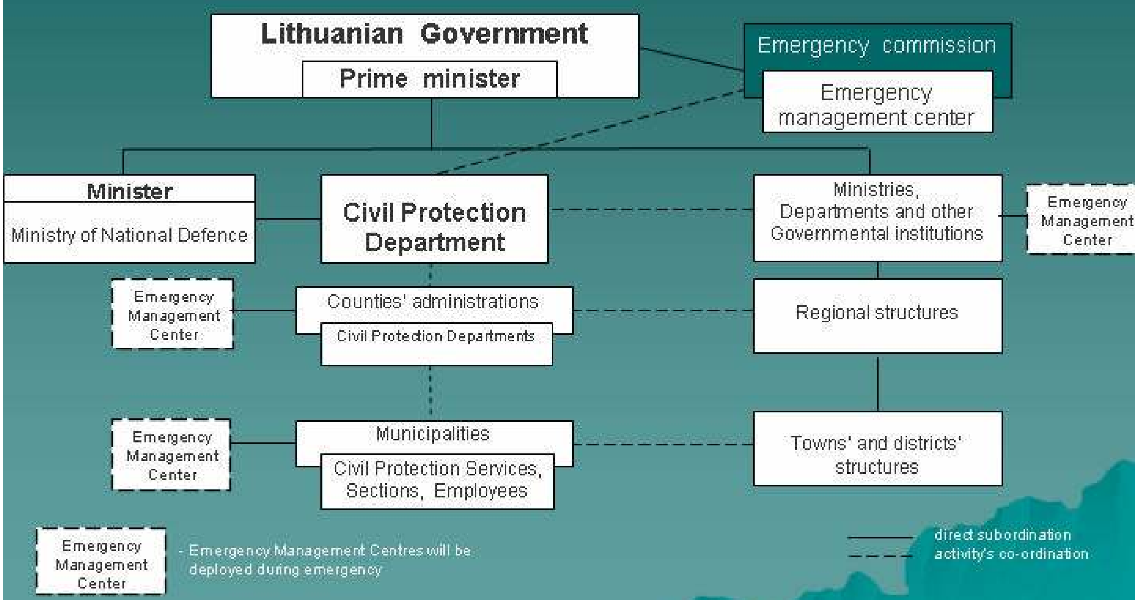
- Floods
- Landslides (karst phenomena)
- Storms
- Forest and peat-bogs fires
- Dam break in case of extreme weather conditions
- Accidents in industrial establishments
- Nuclear power plant
- Pipelines

Emergency management system

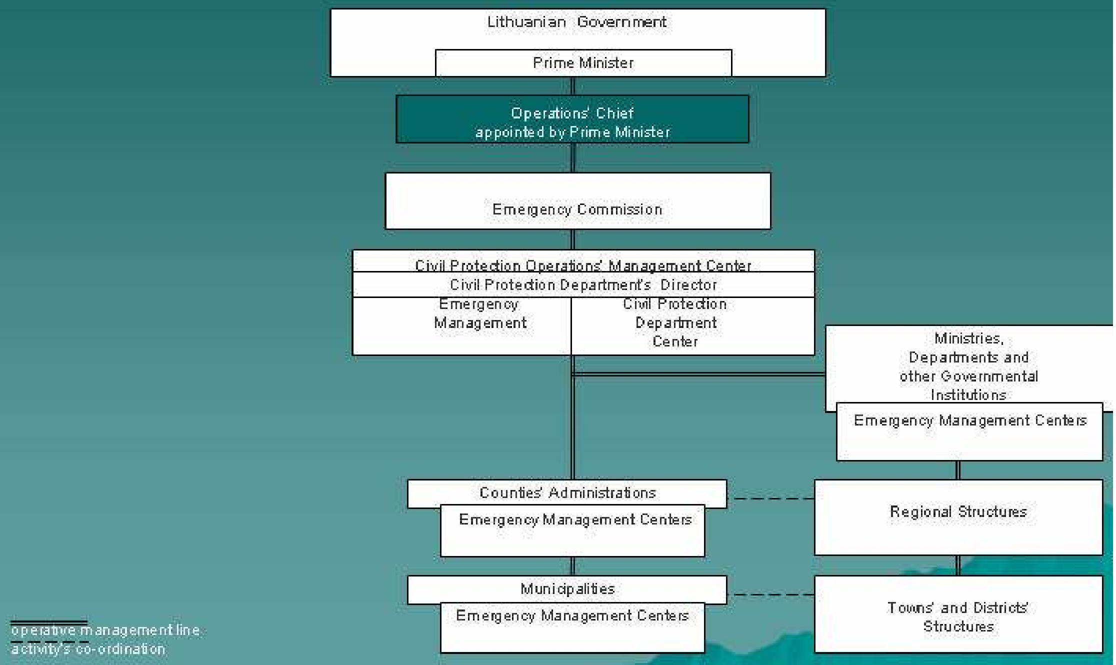
- Management of natural and technological risks and emergencies are performed at these levels:
  - National level
  - County level
  - Municipality level

- Economy entities are responsible for risk management within their territory

Republic of Lithuania
Civil protection system management daily activities
SCHEME



Republic of Lithuania
Civil protection system operative management during emergency
SCHEME



Risk assessment

- Risks posed by all possible natural and technological disasters are assessed at all levels: national, counties, municipalities and industrial facilities
- Risk assessment is carried out considering natural and technological hazards separately and from the point when natural hazards can trigger technological disasters

Risk assessment guidelines

- Legal acts and guidelines for risk assessment and analysis:
  - Recommendations for ministries and governmental institutions on preparation of civil emergency actions plan
  - Recommendations for counties administrations on preparation of civil emergency actions plan;
  - Recommendations for municipalities on preparation of civil emergency actions plan
  - Guidelines on hazard identification and risk assessment and evaluation in dangerous establishment
  - Recommendations on risk assessment of planned industrial activities

Risk assessment guidelines (cont.)

- Guidelines on risk assessment are included in these recommendations
- There are no guidelines for specific risks of technological disasters triggered by natural hazards

Emergency prevention and mitigation measures

- Past emergency situations information data basis and analysis
- Emergency situations prognosis, risk assessment and evaluation of possible consequences for man, environment and property
- Implementation of legislative acts on civil preparedness

Emergency prevention and mitigation measures

- Past emergency situations information data basis and analysis
- Emergency situations prognosis, risk assessment and evaluation of possible consequences for man, environment and property
- Implementation of legislative acts on civil preparedness

Emergency prevention and mitigation measures (cont.)

- Preparation of plans on response actions in case of emergencies (at all levels)
- Information to public in order to prepare public to cope with emergencies
- Running of the Register of Objects of National Significance and Dangerous Establishments
- Land use planning
- Restrictions to transport dangerous goods

Preparedness measures

- Preparedness of Emergency management centers and their personnel
- Preparedness and equipment of civil protection forces (firefighters, civil protection units, volunteers, etc.)
- Training of personnel
- Population warning systems
- Constant technical supervision of dangerous establishments
- Building flood protection systems - levees
- Other

Preparedness measures

- Preparedness of Emergency management centers and their personnel
- Preparedness and equipment of civil protection forces (firefighters, civil protection units, volunteers, etc.)
- Training of personnel
- Population warning systems
- Constant technical supervision of dangerous establishments
- Building flood protection systems - levees
- Other

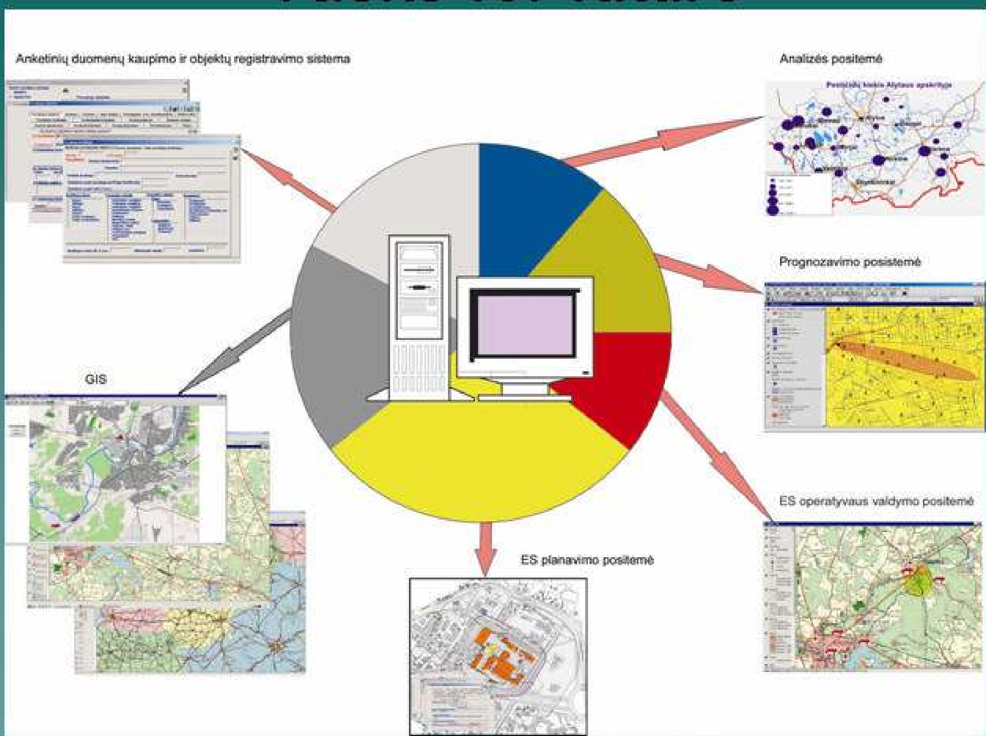
The main laws and regulations

- Law on the Civil Protection
- Law on the Environment Protection
- Law on the Supervision of Potentially dangerous installations
- Provisions on the industrial accidents prevention, dealing with consequences and investigation (Governmental resolution)
- Criteria of emergencies (Governmental resolution)
- Program for flood preparedness and liquidation of consequences in Klaipeda and Taurage counties (Governmental resolution)
- Information of population in case of accidents (Governmental resolution)
- Other

Future activities

- Further improvement of legal basis according to EU legislation
- Improvement of warning system by installation of new equipment
- Hazard mapping on digital maps

Tasks for future

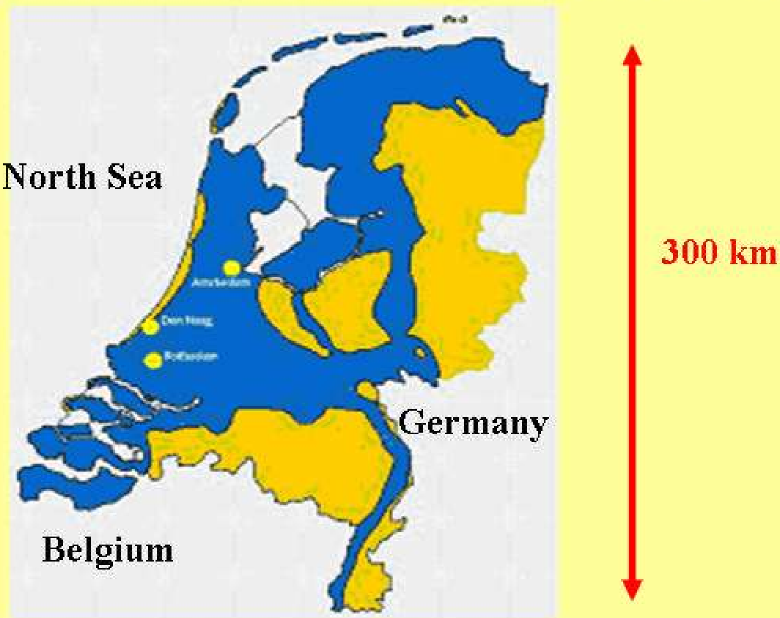



Thank you for your attention!

C6 – Consequences of large scale flooding for the Western part of the Netherlands

Anne VAN DER VEEN
University of Twente, Department of Business, Policy and Technology
P.O. Box 217, 7500 AE Enschede, The Netherlands
A.vanderveen@utwente.nl

Why is flood defence important ?

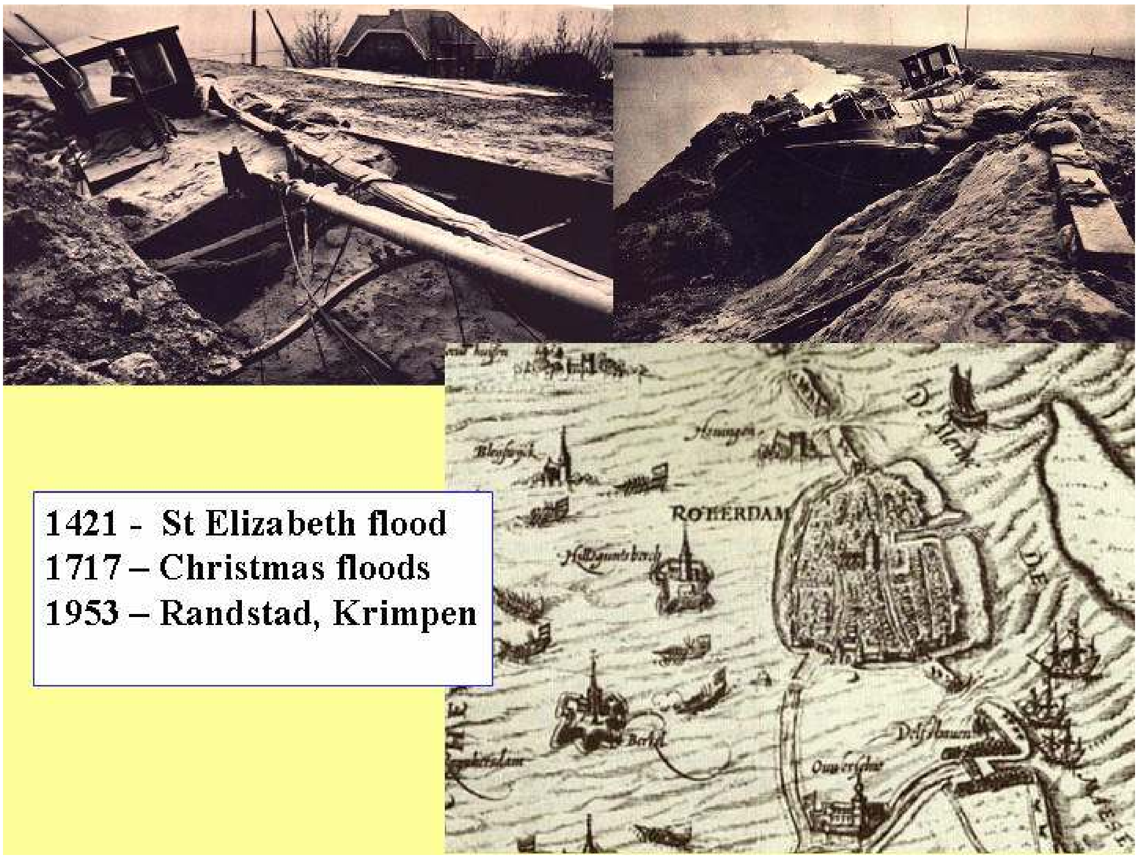


What are the probabilities of flooding in the *western* part of Holland?

- Currently: safety level among the highest of Holland
- However, in the past some bad experiences:

Examples ?

- 1421: St Elizabeth flood
- 1717: Christmas floods
- 1953: initiation of dike break



Design and assessment principles for the Dutch flood defence systems

- risk based principles since 1956
- present elaboration rather primitive
- development into more advanced methods

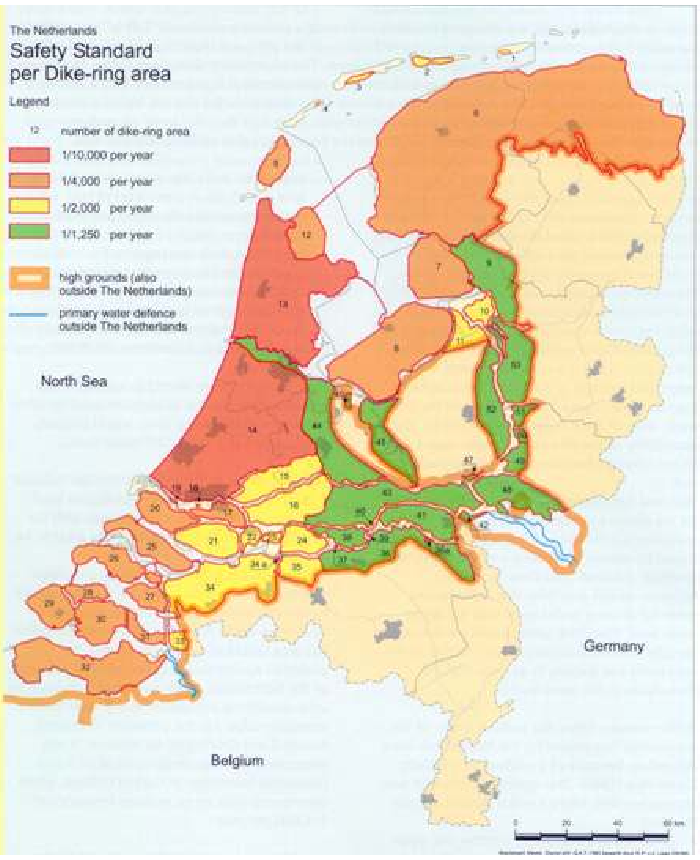
What follows

- Risk based decision making
  - Example based on simulating a flood, presenting a multidisciplinary approach (past two years)
- Integrated Assessment (next two years)

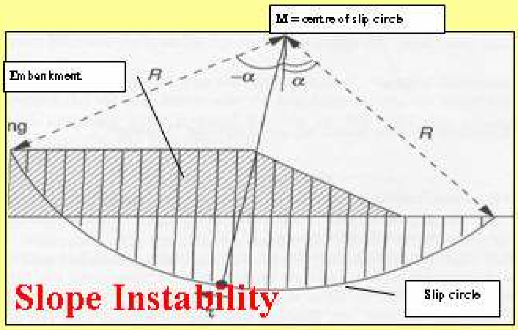
Risk based decision making

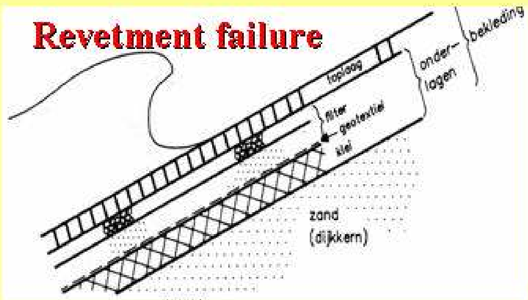
1. definition of the system
2. modelling of failure mechanisms
3. statistical modelling
4. probability calculations
5. consequences modelling
6. risk analysis calculations
7. assessment, management and communication
8. decisions

- **Dike rings**



STEP 2 Modelling Failure mechanisms





Failure of locks, sluices, etc

-overtopping
-piping
-failure of steel and concrete elements
-errors in closing operations

STEP 3 Statistical Modeling

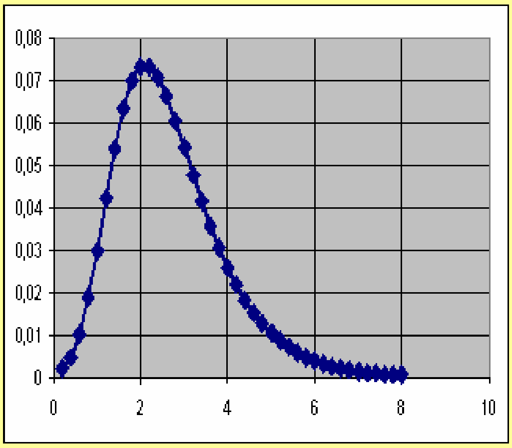
Type

Mean

Standard deviation

Correlation in space

Correlation in time

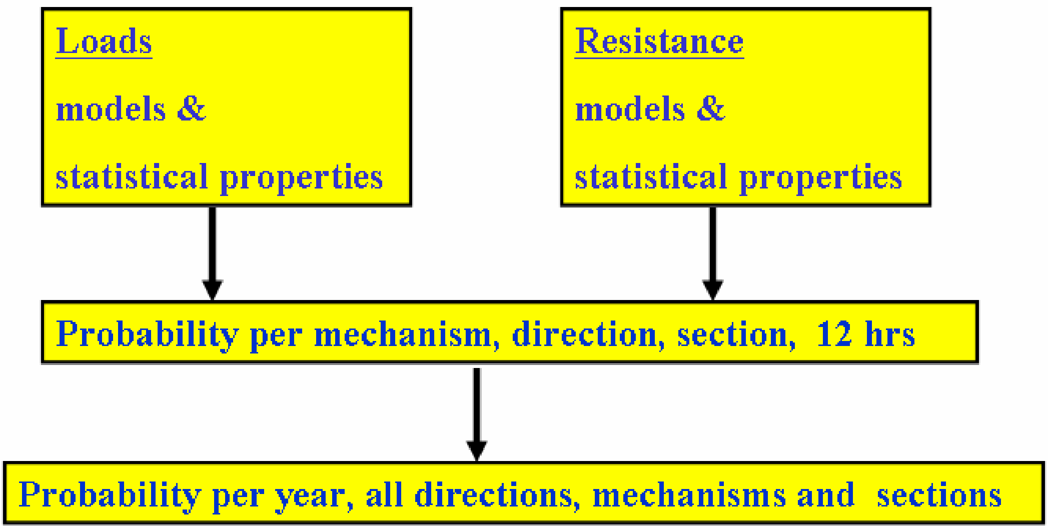


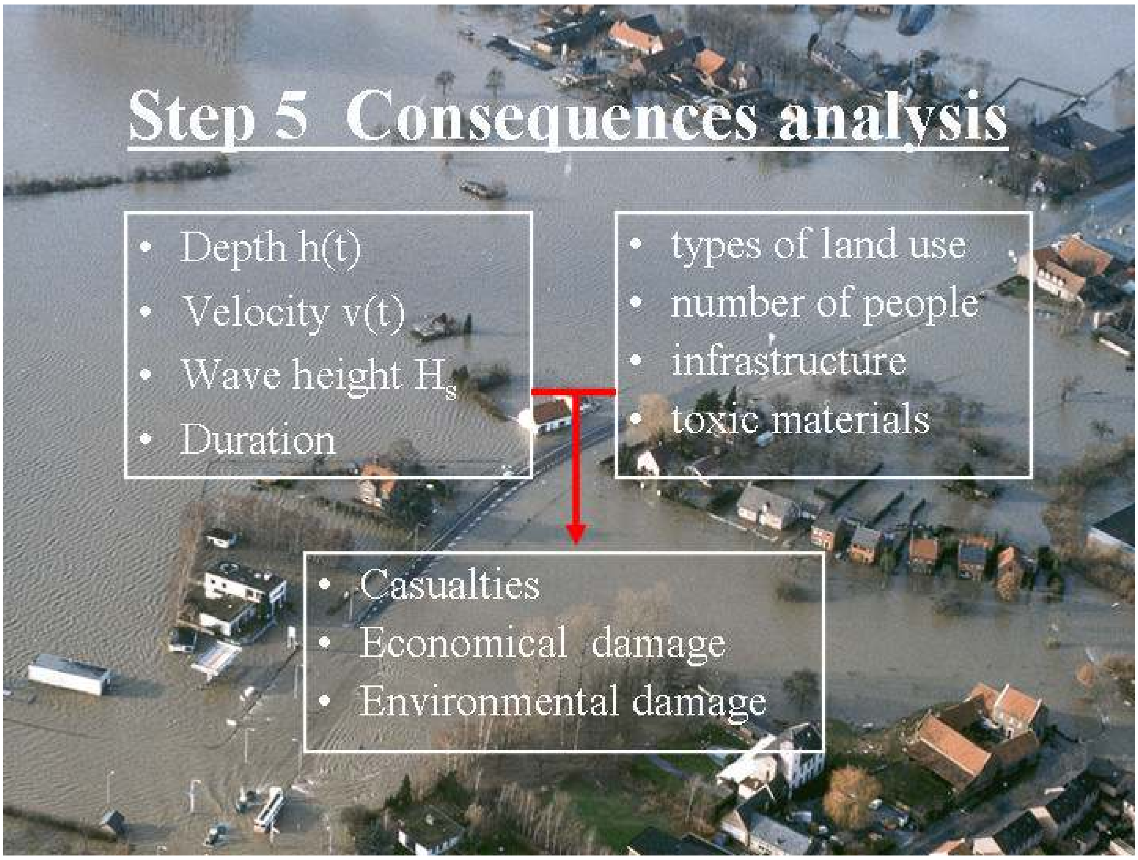
Overview of the random variables

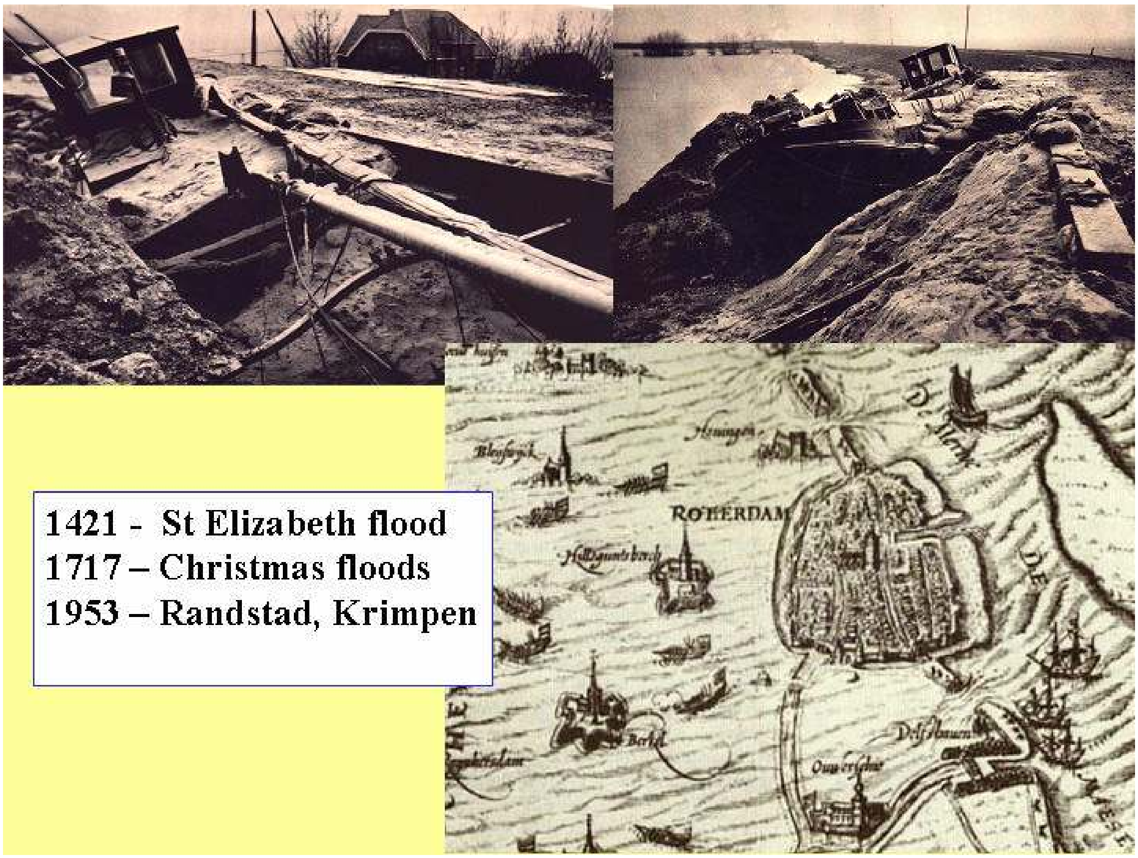
load	geometry	materials	elements
sea levels	dike height	surface roughness	grass properties
wind velocities	toe height	cohesion	revetment density
wind direction	slopes	angle of friction	revetment dimensions
discharges	bottom height	soil density	revetment resistance
lake water levels	dune height	grain size	erosion parameters
inner water levels	layer thicknesses	piping resistance	
storm duration	piping lenght		storage volume
prediction errors			closure operation

model uncertainties
statistical uncertainties

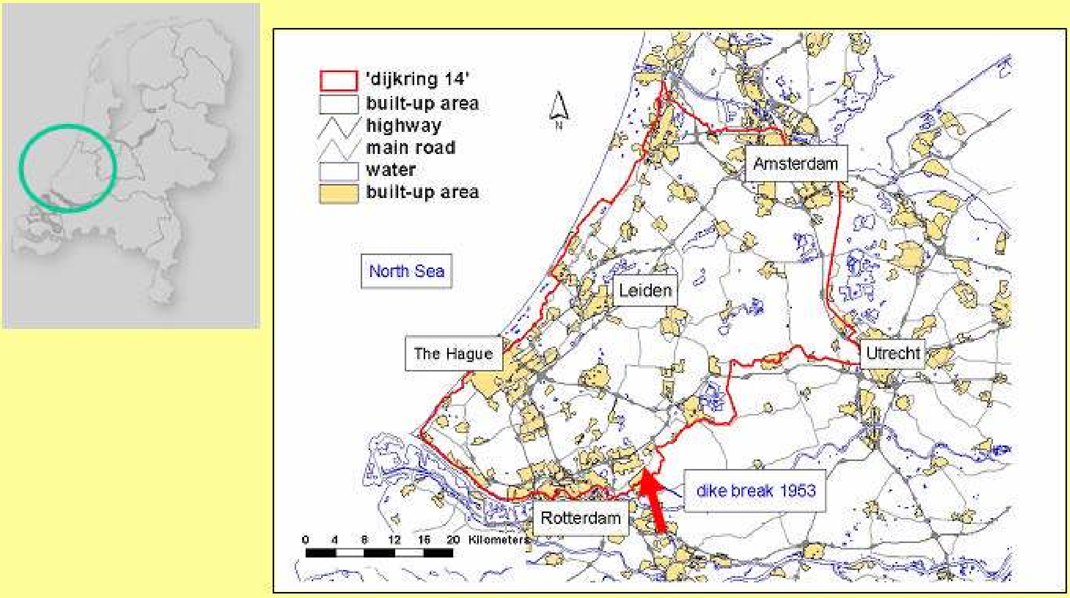
Step 4 Reliability Calculation (PC-Ring)



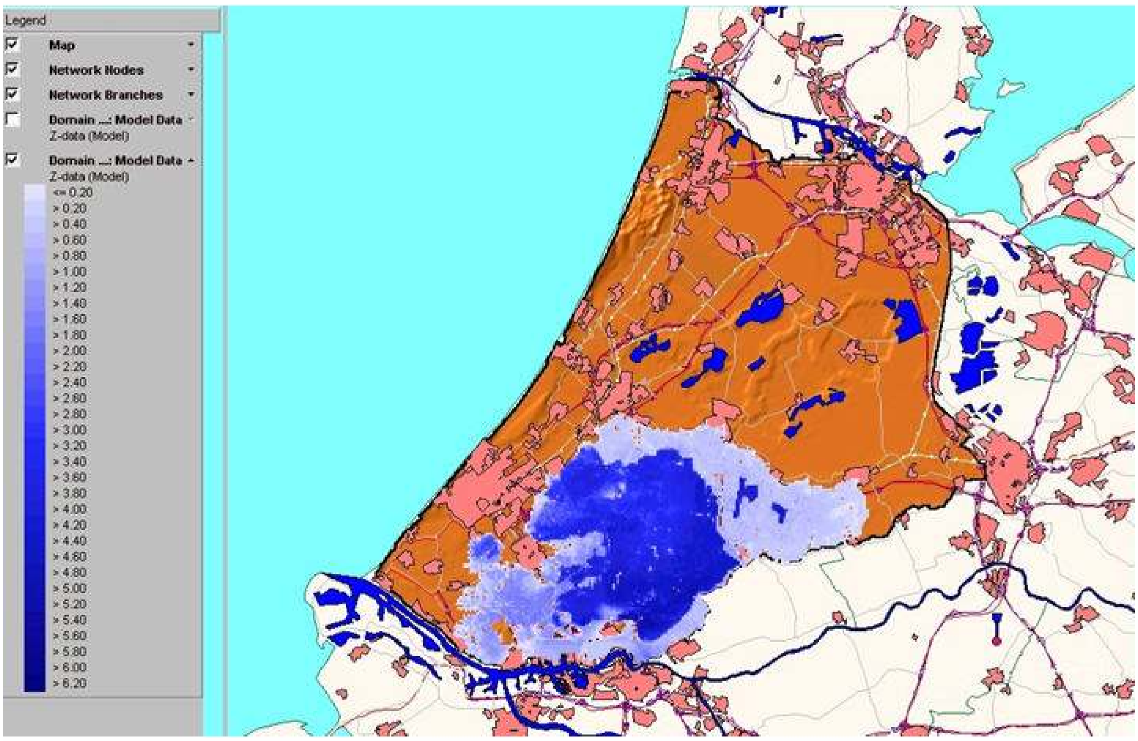

Step 5 Consequences analysis
• Depth h(t)
• Velocity v(t)
• Wave height H$_s$
• Duration
• types of land use
• number of people
• infrastructure
• toxic materials
• Casualties
• Economical damage
• Environmental damage


1421 - St Elizabeth flood
1717 – Christmas floods
1953 – Randstad, Krimpen

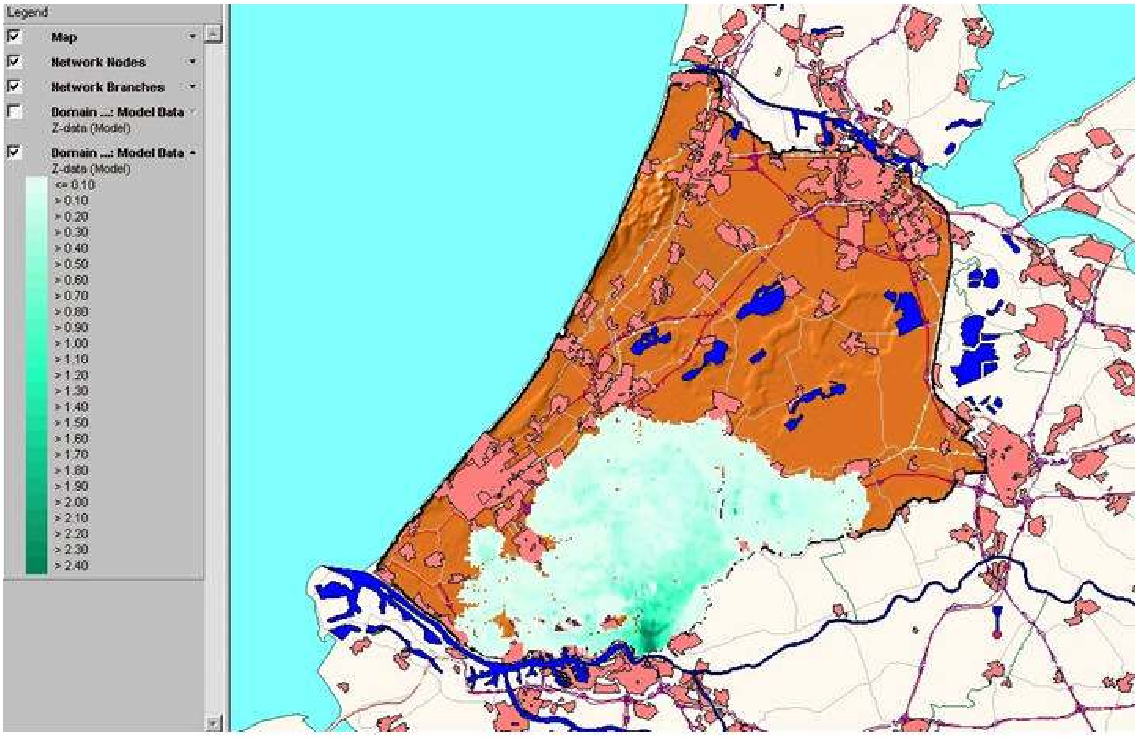
Delft Cluster Case "Central Holland"



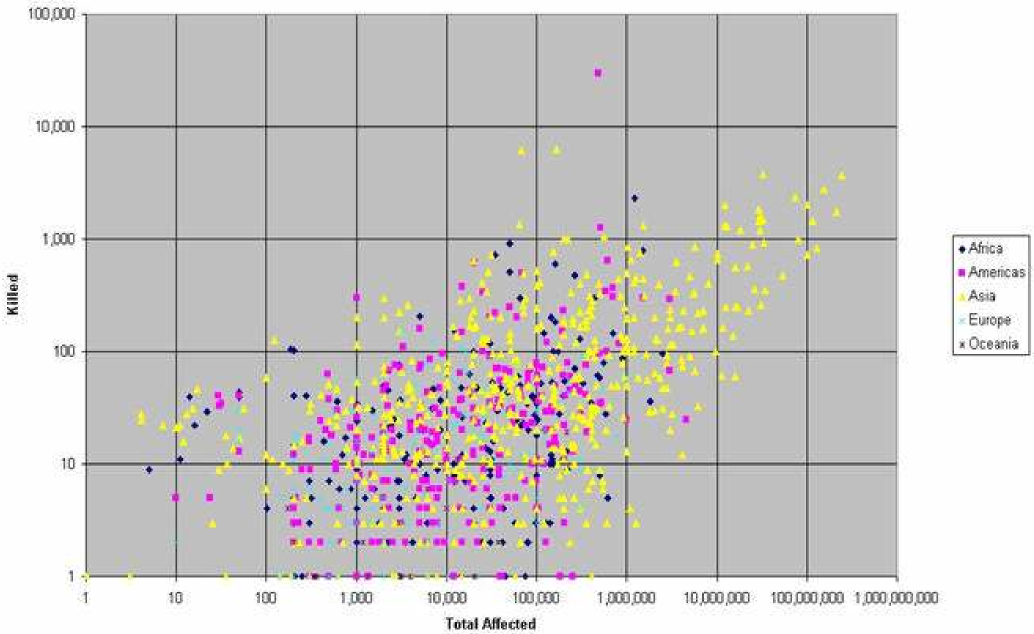
Water depth



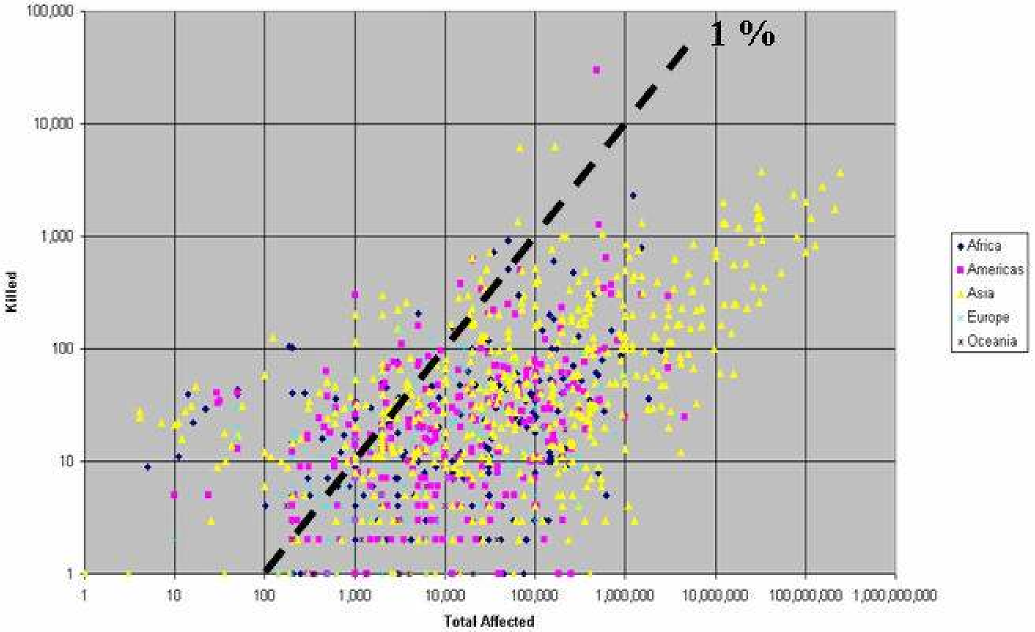
Water velocity

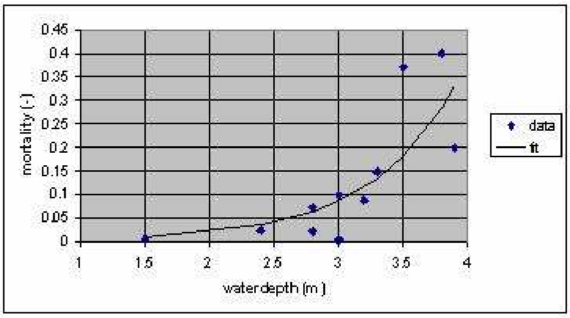


Casualties in flood disasters

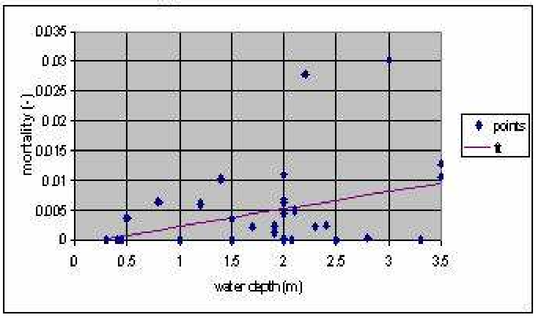


Casualties in flood disasters

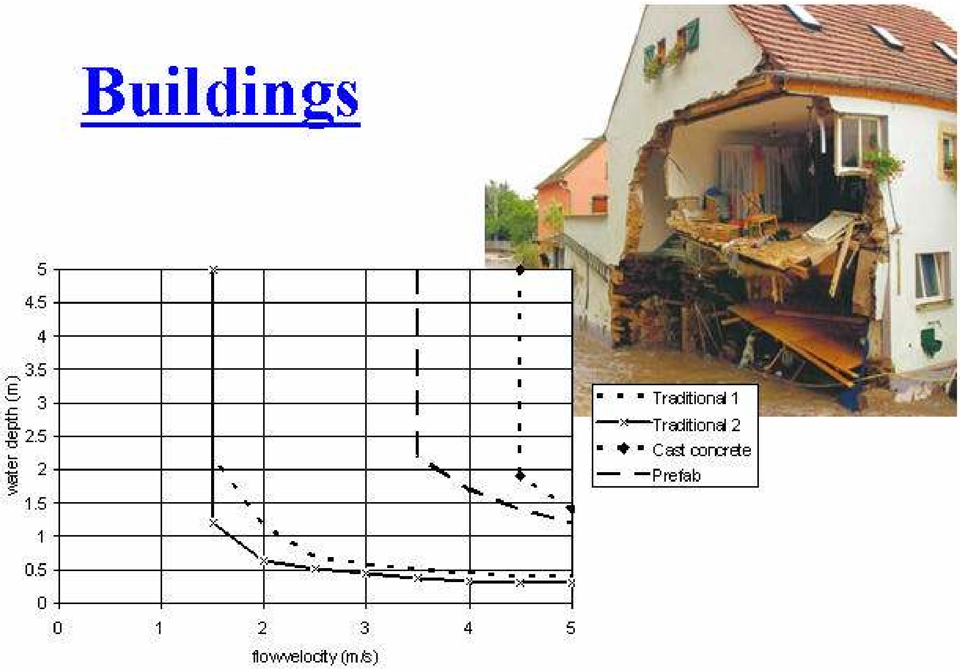




Models for estimating casualties



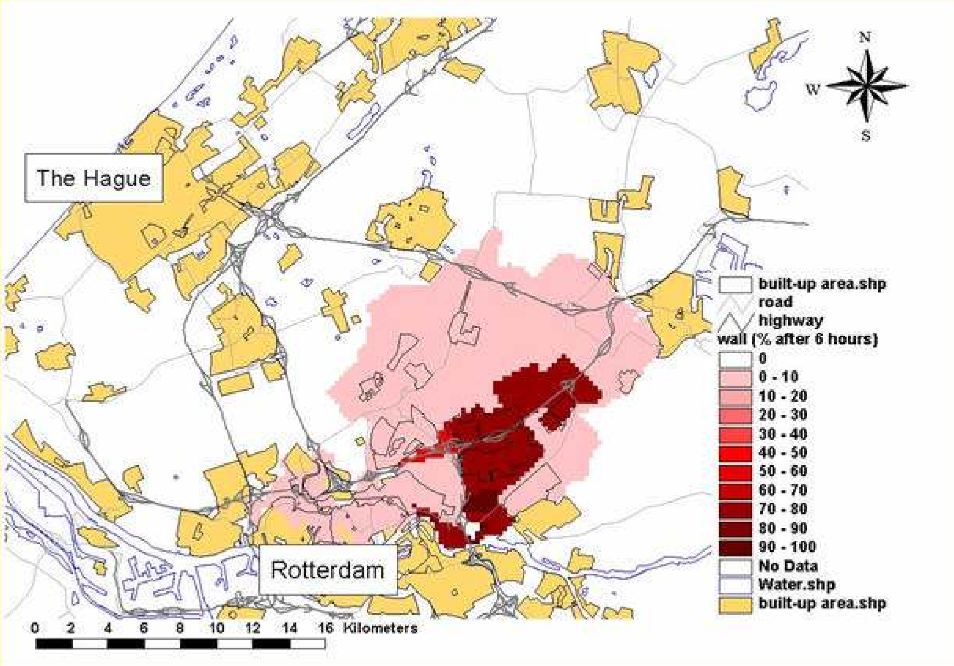
Buildings



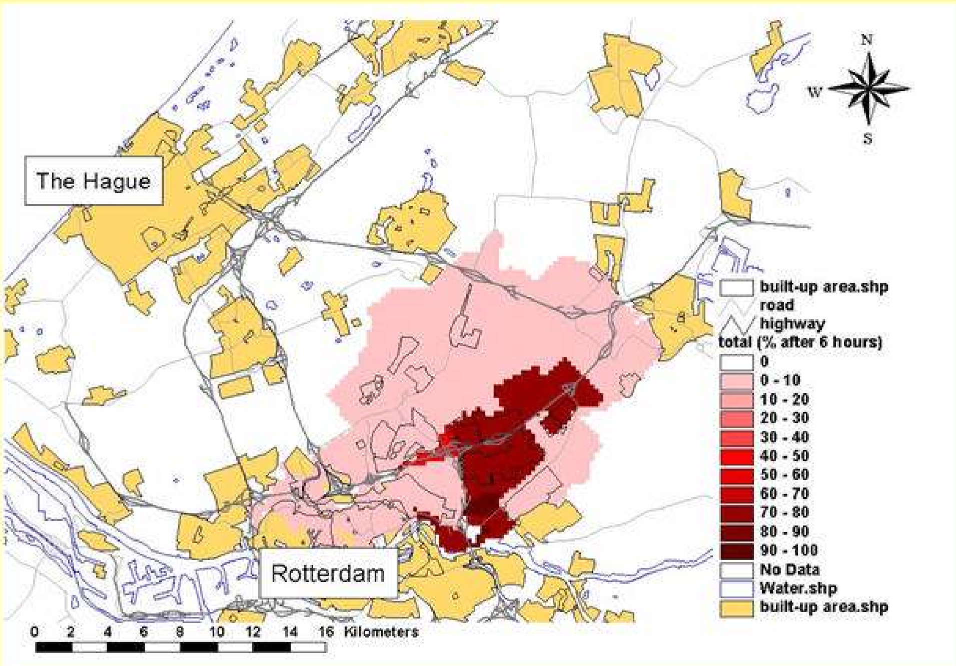
Damage to buildings

- Scour of the foundation
  - Water velocity
  - Type of surface layer of the ground
- Failure of the retaining walls
  - Water velocity
  - Water depth
  - Waves
  - Furniture

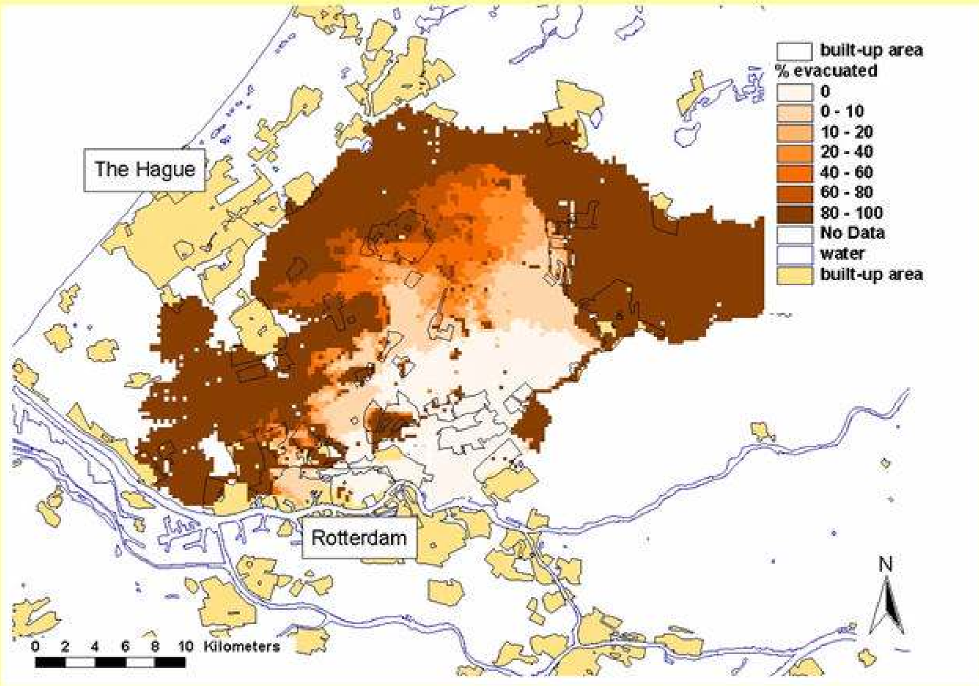
Damage to walls



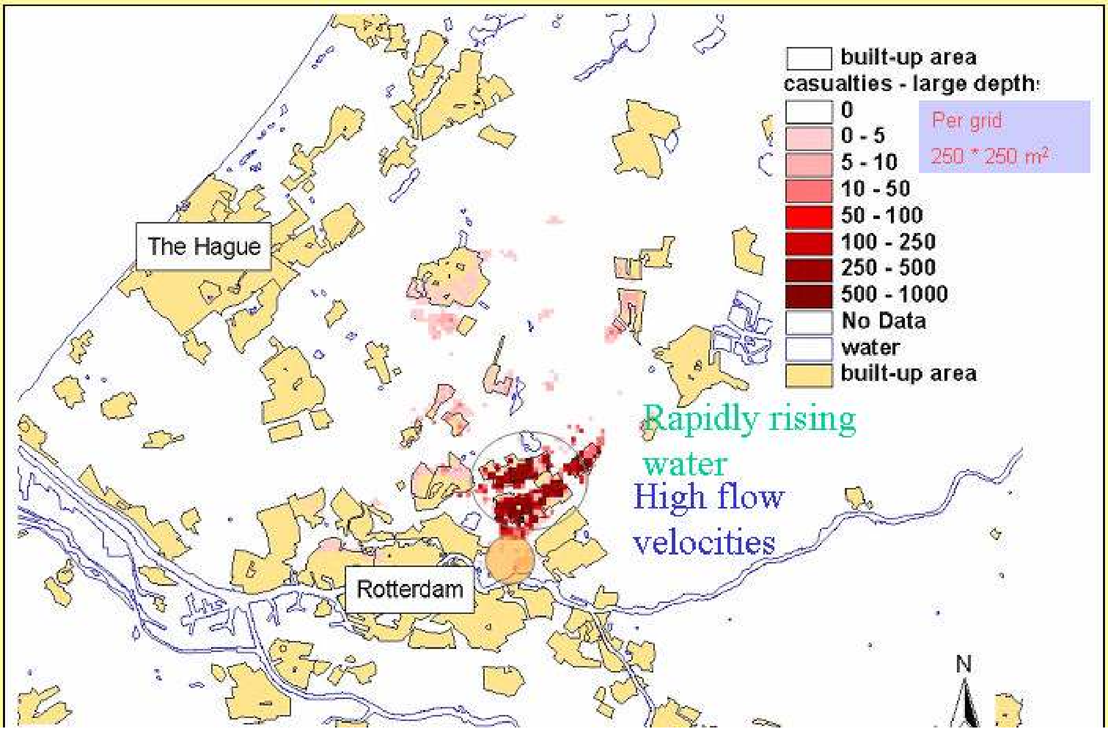
Total damage



Percentage evacuated



Estimated number of casualties



Results of case study

	number
inhabitants dike ring area	3 500 000
inhabitants inundated area	942 334
inhabitants unable to escape	485 795
inhabitants unable to escape, living in high-rise buildings	40 354
fatalities due to high flow velocities	5 035
fatalities due to large water depths, rapid rise	66 453
fatalities due to large water depths, slow rise	2 154
total nr of fatalities	70 000
inhabitants killed versus total population	7 %

Table 5.1 Estimated number of fatalities using the evacuation function based on a required time of 50 hours

Economic consequences

Direct losses

- *Physical damage translated into money*
- *Damage to households*
- *Damage to public property*
- *Damage to firms*

Indirect economic losses:

- *A result of dislocations suffered by economic sectors not sustaining direct damage.*

Direct economic losses

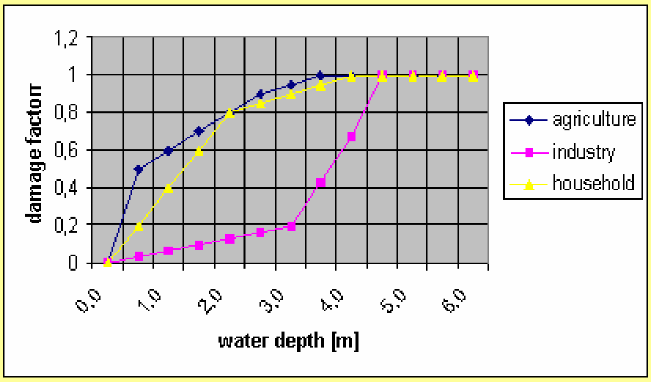
$$C = \Sigma\, \alpha_k c_k n_k$$

α = damage factor

c = maximum damage

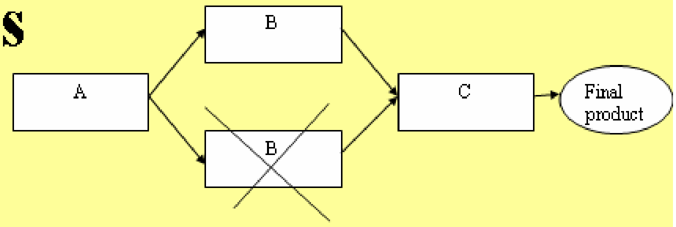
n = number

k = category



	maximum damage c	
agriculture	**3 000 000**	**Euro per km^2**
industry	**200 000**	**Euro per employee**
households	**150 000**	**Euro per house**

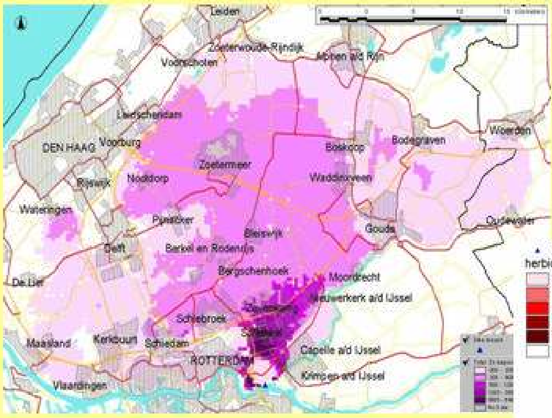
Indirect economic effects



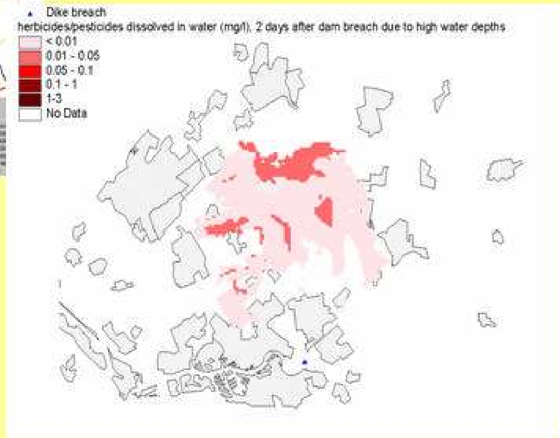
	Agricul-ture	Industry	Service	*Export, investment, consump-tion, government*	Total produc-tion
Agricul-ture	X_{11}	X_{12}	X_{13}	F_1	X_1
Industry	X_{21}	X_{22}	X_{23}	F_2	X_2
Services	X_{31}	X_{32}	X_{33}	F_3	X_3
Import	I_1	I_2	I_3		
Wages, profits	W_1	W_2	W_3		

Environmental consequences

zinc



pesticides



Removing costs	5-10 Euro/m³
Transportation costs	5-10 Euro/m³
Deposit costs	25-35 Euro/m³
Total cost	35 tot 55 Euro/m³

Total estimation cleaning all contamination 350-550 MEuro

STEP 6 Risk analysis calculation

Standard case:

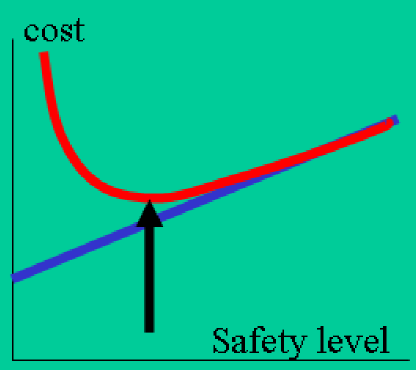
$$\text{Risk} = P_F * C$$

But: consequences may depend on failure mode or values of random variables

Step 7 Assessment, management and communication

- present situation
- possible measures
- optimisation
- human safety criteria
- risk communication

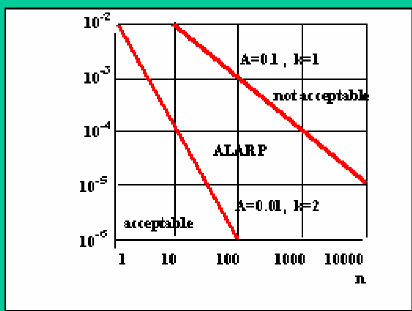
Decision criteria



Economic optimization

$P(\text{casualty}) < \beta\ 10^{-4}$ per year

Individually acceptable level of risk



Socially acceptable level of risk

Risk Communication

with whom ?

civil servants

politicians

press

public

How make the step from multidisciplinary research towards Integration ?

- **Differences in language**
- **Differences in paradigms**
- **Differences in knowledge interest**

Differences between technical and social sciences

- Scientific rationality has long be seen as an empirical analytic procedure:
  - Strictly neutral, objective, carefully controlled sense observation of physical and social facts, corresponding to a:
    - Knowledge interest : mainly the domain of human control over physical and social environment; however:
  - There are more possible knowledge interests

Knowledge interests and action domains

- Human control over physical and social environment
- Interaction and mutual understanding of motives and meanings
  - Relationship between unconscious collective images and interactions implies the need for articulation, reflection and critique.

Implication for scientific rationality

- **Enlarge scientific rationality with:**
  - **Empirical analysis of data, skillful interpretation of socially constructed meanings, and social critique.**
- **Science is fallible: open the concept of rationality with learning and a critical dialogue**

Conclusions

- Multidisciplinary research is a step in the direction of Integrated Assessment
- Integrated Assessment is more than Risk Communication

Section D

PARALLEL WORKING SESSIONS AND RESULTS

The workshop included a day and a half of parallel working sessions and discussion. During the parallel sessions, the country representatives were divided into two groups, and each group worked together to address a series of questions concerning natech disaster impacts, vulnerability, and risk reduction. The individual workgroups then convened in a plenary session at the end of each day to present the workgroup results and allow for discussion.

1 WORKING SESSION DYNAMICS

Each group had an assigned rapporteur and a moderator. The moderator did not participate in the discussion, but served as a facilitator during the exercise. A few targeted questions, described in subsequent sections, were posed to each group. The questions were addressed openly by each group according to the rules assigned by the moderator. Each group had a designated time to discuss the questions and related issues. The rapporteur, with the help of the group participants, prepared a written summary of the results of each working session. The results of each group were later presented and discussed during the plenary session that followed.

2 WORKING SESSION RESULTS

Activity 1

The following description of a natech disaster was presented to both groups:

> *"A natech disaster is a technological disaster triggered by any type of natural disaster. The technological disaster can include damage to industrial facilities (including lifelines) which results in significant adverse effects to the health of people, property, and/or the environment."*

The participants were asked to discuss and add any other types of technological disasters which they thought should be included in the description. There was consensus that a natural disaster triggered technological disaster (natechs) refers to the impact of a natural hazard on:

i) Industrial facilities housing hazardous materials (large, medium and small),
ii) Hazardous materials storage facilities, including port terminals,
iii) Gas and oil pipelines,
iv) Water supply systems,
v) Transportation of dangerous goods
vi) Energy production systems.

Activity 2

Country representatives were asked to provide a qualitative estimate of the probability of a natech occurring in their country supposing that a major natural disaster, such as the 500 year earthquake or the 100 year flood, occurred and impacted a major city. More than half of the participants said that if a natural disaster affected a major city in their countries the probability of a natech occurring is 50 % or more, about a fourth of the participants said the probability was 20 %, and the other fourth said the probability was low ranging from 1-5 %. There was however, general agreement that the potential for natech disasters exists, and that they should be addressed.

Activity 3

The participants were asked to identify the factors that affect vulnerability to natech disasters. In addition, the groups were asked to identify who are the main stakeholders.

There was consensus that both people and organizations are likely to be affected if a Natech occurs. Some examples include people living close to factories, companies (workers, facilities), the environment, schools or hospitals in the proximity of industrial facilities or other hazardous establishment.

Therefore, it was agreed that it is the presence of people and human activity that determines vulnerability to any type of hazard. The following are some of the factors that could increase or decrease vulnerability to a natech event:

- Presence of people.
- Geographical features of a region.
- Building use.
- Urbanisation.
- Time when the event occurs (day/night, week/weekday, summer/winter).
- Land-use (spatial planning).
- Climate change.
- Overloading of the technological system's capacity.
- Maintenance and operational procedures at the plant.
- Risk management programs at the plants.
- Training of responders for natechs.
- Information and education of the population; different education needed for different natechs.
- Access to information and/or having the appropriate channels for information dissemination.
- Inter-connectedness of systems, and complexity can contributes to making a country more vulnerable to natechs. This is particularly true in large metropolitan areas.
- Presence or absence of technology. Some countries have very little technology, and they may be less vulnerable to natechs. However, there may be less strict regulations, therefore if a natech does occur the results may be more catastrophic.
- Society's level of preparedness: resources, plans, mitigation, legislation.
- Socio-economic factors such as life styles, living standards, education, etc.
- Population density, age distribution, and other demographic characteristics.
- Potential for cross-boundary effects.

Activity 4

Based on the results of the previous activities, each group was asked to propose a set of strategies for natech risk reduction. The proposed strategies were classified according to the various phases of disaster (prevention, preparedness, response and recovery), and prioritised according to different criteria. There was general consensus that strategies for natech risk reduction should include the following:

- ***Emergency planning***, including prevention and mitigation, and response planning for natechs at all levels of government.
- ***Education of the public***, government agencies involved in emergency management, as well as decision-makers. For example, training of emergency responders (e.g. fire teams, hazardous materials response teams), training of medical personnel at hospitals for treatment of patients exposed to toxic chemicals, etc.
- ***Public participation in natech risk reduction planning***. Some countries felt that natech risk management should incorporate much public participation in order to better understand a) the local population's perception of the level of the natech risk and b) the level of natech risk they are willing to accept.
- ***Industry risk management which specifically address the potential impacts of natural hazards on their installations***. For example, modifying the Seveso II Directive (96/82/EC) and ADR Framework Directive (94/55/EC) to include natural-hazard triggers was proposed as one of the strategies that could be adopted to achieve this. Additional risk management actions which can be promoted to make plants less vulnerable to natechs were also discussed including: the use of redundant safety systems, natural hazard-resistant designs, the provision of guidelines to inform industry about natech planning, and requiring the strategic placement of hazardous substances inside a plant.
- ***Land use planning***, as an important technique for separating residents and hazardous facilities; and risk mapping, possibly tied to a centralized information centre, to facilitate natech risk reduction.

Section E:
APPENDICES

APPENDIX 1

List of participants

NEDIES Meeting on Analysis of natech disaster (Natural Hazards Triggering Technological Disasters) Management

JRC- Ispra - Bldg. 36 - Room 2

20/10/2003 - 21/10/2003

AUSTRIA

Reinhold DORFLINGER

Amt der Kärntner Landesregierung
Arnulfplatz 1
A - 9020 KLAGENFURT
tel. :+43 463 53622898 - fax: +43 463 53630198
e mail: reinhold.doerflinger@ktn.gv.at

BULGARIA

Dimitar DONKOV

State Agency for Civil Protection
30 N. Gabrovski Str.
BG - SOFIA
tel. :+359 2 96010235 - fax: +359 2 8688115
e mail: it@cp.government.bg

CYPRUS

Panayiotis Michael KATSOURAS

Civil Defence
63 Pericleous Street PO Box 23830
CY - 1686 NICOSIA
tel. :+357 22 403413 - fax: +357 22 315638
e mail: ge.cd@cytanet.com.cy

FINLAND

Veli-Pekka IHAMAKI

Depart. For Rescue Services, Ministry of Interior
Kirkkokatu 12
FIN - 00023 GOVERNMENT
tel. :+358 9 16042719 - fax: +358 9 16044672
e mail: veli-pekka.ihamaki@intermin.fi

FRANCE

Agnes VALLEE
INERIS
Parc Technologique ALATA - BP 2
F - 60550 VERNEUIL-EN-HALATTE
tel. :+33 3 44556244 - fax: +39 3 44556295
e mail: agnes.vallee@ineris.fr

GERMANY

Bernd ZAAYENGA
Bayer. Staatsministerium des Innern
Odeonsplatz 3
D - 80539 MUNCHEN
tel. :+49 89 21922682 - fax: +49 89 21922612
e mail: bernd.zaayenga@stmi.bayern.de

HUNGARY

Zoltan CSÉPLO
National Directorate General for Disaster Management
Mogyoródi út 43
H - 1149 BUDAPEST
tel. :+36 1 4694152 - fax: +36 1 4694199
e mail: zoltan.cseplo@katved.hu

ITALY

Marta DI GENNARO
Dipartimento Protezione Civile della
Presidenza del Consiglio dei Ministri
Via Ulpiano 11
I - 00193 ROMA
tel. :+39 06 68202650 - fax: +39 06 68202687
e mail: marta.digennaro@protezionecivile.it

Loretta FLORIDI
Dipartimento Protezione Civile della
Presidenza del Consiglio dei Ministri
Via Ulpiano, 11
I - 00193 ROMA
tel. :+39 06 68202389 - fax: +39 06 68202440
e mail: industriale@protezionecivile.it

JAPAN

Tetsushi KURITA
Asian Disaster Reduction Center
Hitomiraikan 5F, 1-5-2 Wakinohamakaigan-dori Chuo-ku
J - 651-0073 KOBE
tel. : +81 78 2625540 - fax: +81 78 2625546
e mail: kurita@adrc.or.jp

LITHUANIA

Petra VOVERIS

Civil Protection, Dept. at Ministry National
Defence Rep. Lithuania
Pamenkalnio str. 30
LIT - 2600 VILNIUS
tel. :+370 5 2785325 - fax: +370 5 2624564
e mail: petras.voveris@csd.lt

NETHERLANDS

Anne VAN DER VEEN

University of Twente
P.O. Box 217
NL - 7500 AE ENSCHEDE
tel. :+31 53 4893213 - fax: +31 53 4894734
e mail: a.vanderveen@utwente.nl

PORTUGAL

Catarina VENANCIO

National Service for Fire and Civil Protection
Av.do Forte ,Edif.Proteccao Civil
P - 2799-512 CARNAXIDE
tel. :+351 21 4247103 - fax: +351 21 4247180
e mail: catarinav@snbpc.pt

ROMANIA

Septimius MARA

Ministry of Agriculture, Forests, Waters and
Environment
Bld. Libertatii no 12, sect.5
RO - BUCHAREST
tel. :+40 21 4102032 - fax: +40 21 4102032
e mail: smara@pcnet.ro

SWEDEN

Mattias STROMGREN

Swedish Rescue Services Agency

S - 651 80 KARLSTAD
tel. :+46 54 135126 - fax: +46 54 135620
e mail: mattias.stromgren@srv.se

UNITED STATES

Laura J. STEINBERG
Tulane University
206 Blessey Hall
USA - NEW ORLEANS
tel. :001 504 8623254 - fax: 001 504 8623254
e mail: lauras@tulane.edu

EUROPEAN COMMISSION

Javier HERVAS DE DIEGO
European Commission, JRC - IPSC
Via E. Fermi 1 TP 210
I - 21020 ISPRA (VA)
tel. :+39.0332.785229 - fax: +39.0332.789007
+39.0332.785813
e mail: javier.hervas@jrc.it

Jean Pierre NORDVIK
European Commission, JRC - IPSC
Via E.Fermi.1 TP 670
I - 21020 ISPRA (VA)
tel. :+39.0332.782021 - fax:
e mail: jean-pierre.nordvik@jrc.it

Boyko RANGUELOV
European Commission, JRC - IPSC
Via E. Fermi 1 TP 210
I - 21020 ISPRA (VA)
tel. :+39.0332.789406 - fax: +39.0332.789007
+39.0332.789007
e mail: boyko.ranguelov@jrc.it

Ana Lisa VETERE ARELLANO
European Commission, JRC - IPSC
Via E.Fermi.1 TP 670
I - 21020 ISPRA (VA)
tel. :+39.0332.9188 - fax:
e mail: ana.vetere@jrc.it

UNITED NATIONS
INTERNATIONAL STRATEGY FOR DISASTER REDUCTION

Francesco PISANO
UN/ISDR
Palais de Nations
CH - 1210 Geneva, Switzerland
tel. :+41 22 9179716 – fax. : +41 22 9179098
e mail: pisanof@un.org

Ana Maria CRUZ
UN/ISDR Seconded Researcher to the EC-JRC NEDIES Initiative (23 Sept - 29 Nov/03)
European Commission – JRC - IPSC
Via Fermi, 1 TP 670
I-21020 Ispra (VA) ITALIA
Tel. no. +39 - 0332 - 78 9794, Fax no. +39 - 0332 - 78 9007
email ana-maria.cruz@jrc.it

Department of Civil and Environmental Engineering (after 1 Jan/03)
Tulane University
New Orleans, LA 70118, USA
Tel. no. (504) 862 3257, Fax no. (504) 862 8941
acruz@tulane.edu

APPENDIX 2

Workshop Programme

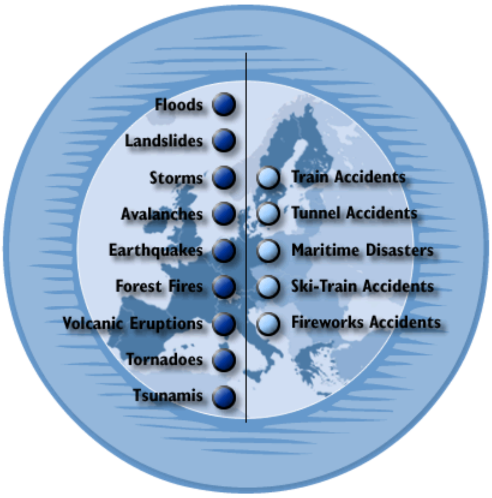
Monday, 20 October 2003

09:00 – 09:30 Building 36, Room 2	**REGISTRATION**
09:30 – 10:00 Building 36, Room 2	**WELCOME AND OPENING ADDRESS** *Jean Pierre Nordvik, EC-JRC* *Francesco Pisano, UN/ISDR*
10:00 – 11:20 Building 36, Room 2	**KEY NOTE SPEAKERS** **Italy Blackout, 28 September, 2003** *Marta Di GENNARO, Dipartimento della Protezione Civile - Presidenza del Consiglio dei Ministri, Italy* **Cascading Events Leading to Hazardous Materials Releases During the Turkey Earthquake of August 1999** *Ana Maria CRUZ, UN/ISDR* **Observation on the Recent Earthquake Damage in Japan** *Tetsushi KURITA, Asian Disaster Reduction Center, Japan* **Natechs in the US: Experience, Safeguards, and Gaps** *Laura J. STEINBERG, Civil and Environmental Engineering, Tulane University, United States* **Simulating a Large-Scale Flood: Developing a NATECH Methodology** *Anne VAN DER VEEN, University of Twente, Netherlands*
11:20 – 11:40	**COFFEE BREAK**
11:40 – 13:00 Building 36, Room 2	**COUNTRY PRESENTATIONS** **Information System for the Mitigation and Reduction of the Consequences of Accidental Events** *Marta Di GENNARO and Loretta FLORIDI, Dipartimento della Protezione Civile - Presidenza del Consiglio dei Ministri, Italy* **Flood Disasters in the Pre-Alpine Area of Corinthia** *Reinhold DORFLINGER, Amt der Kärntner Landesregierung Austria* **Natech Disaster Risk Management on the Territory of Bulgaria** *Dimitar DONKOV, State Agency for Civil Protection, Bulgaria* **Natural and Technological Risk Management** *Panayiotis Michael KATSOURAS, Civil Defence, Cyprus* **Natech Disasters in Finland: Are There Any?** *Ihamäki VELI-PEKKA, Rescue Services, Ministry of the Interior, Finland* **Natech Disaster Risk Management in France** *Agnes VALLE, INERIS, France* **Risk Administration by the Example of Bavaria** *Bernd ZAAYENGA, Bayer. Staatsministerium des Innern, Germany*
13:00 – 14:20 Salletta Mensa	**LUNCH**

14:20 – 15:10 Building 36, Room 2	**COUNTRY PRESENTATIONS** **Preparations to Natech Disasters in Hungary** Zoltan CSÉPLO, National Directorate General for Disaster Management, Hungary **Natural and Technological Disasters Risk Management in Lithuania** *Petra VOVERIS, Department of Civil Protection, Ministry of National Defence, Lithuania* **Natech Risk Management in Portugal** *Catarina VENANCIO, National Service for Fire and Civil Protection, Portugal* **Lessons Learnt From the Baia Mare Cyanide Spill (2000, January 30, North-Western Romania)** *Septimius MARA, Ministry of Agriculture, Forests, Waters and Environment, Romania* **Swedish Natech Activities** *Mattias STROMGREN, Swedish Rescue Services Agency, Sweden*
15:10 – 15:30 Building 36, Room 2	**INTRODUCTION TO WORKING SESSION I** Break up into selected working groups
15:30 – 16:50	**WORKING GROUP A** (Room 2) / **WORKING GROUP B** (Room 10)
16:50 – 17:10	**COFFEE BREAK**
17.10 – 17:20 Building 36, Room 2	**WORKING GROUP A WRAP UP** / **WORKING GROUP B WRAP UP**
17:20 – 18:00 Building 36, Room 2	**PRESENTATIONS BY GROUP RAPPORTEURS AND DISCUSSION**
18:00	**TRANSPORT TO HOTEL**
20:00 Hotel Conca Azzurra	**DINNER**

Tuesday, 21 October 2003

09:00 – 09:20 Building 36, Room 2	**INTRODUCTION TO WORKING SESSION II** Break up into selected working groups
09:20 – 11:00	**WORKING GROUP A** (Room 2) / **WORKING GROUP B** (Room 10)
11:00 – 11:20	**COFFEE BREAK**
11:20 – 12:10 Building 36, Room 2	**PRESENTATIONS BY GROUP RAPPORTEURS AND DISCUSSION**
12:10 – 12:40 Building 36, Room 2	**WRAP-UP AND CHALLENGES FOR THE FUTURE**
12:40 – 14:00 Salletta Mensa	**LUNCH**
14:00	**ADJOURN**



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LESSONS LEARNT

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PROCEEDINGS

Anne van der Veen, Ana Lisa Vetere Arellano and Jean-Pierre Nordvik (Editors), 2003. ***Proceedings: NEDIES Workshop – In search of a common methodology on damage estimation***, Report EUR 20997 EN, pp.301.

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GUIDELINES/RECOMMENDATIONS

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Alessandro G. Colombo, Javier Hervás and Ana Lisa Vetere Arellano, 2002. ***NEDIES Project – Guidelines on Flash Flood Prevention and Mitigation***, Report EUR 20386 EN, pp. 64.

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Carmelo Di Mauro, Ana Lisa Vetere Arellano, Boyko Ranguelov, Javier Hervas, Robert Peckham, Michalis Christou, Stuart J. Duffield, Maureen Wood, Jean-Pierre Nordvik, Alfredo C. Lucia, 2003. ***Questionnaire: Risk Mapping - Natural and Technological Risks and Contaminated Lands***, S.P.I.03.222, pp. 210.

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