FP7 Grant Agreement N° 312450

CIPRNet

Critical Infrastructure Preparedness and Resilience Research Network

Project type:	Network of Excellence (NoE)	
Thematic Priority:	FP7 Cooperation, Theme 10: Security	
Start date of project:	March 1, 2013	Duration: 48 months

D6.2 Application scenario

Due date of deliverable: 31/05/2014
Actual submission date: 14/07/2014

Revision: Version 1

Commissariat à l'Energie Atomique et aux Energies Alternatives (CEA)

Project co-funded by the European Commission within the Seventh Framework Programme (2007–2013)		
Dissemination Level		
PU	Public	
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	**X**

Author(s)	Yohan Barbarin (CEA), Marianthi Theocharidou (JRC), Erich Rome (Fraunhofer)
Contributor(s)	Jingquan Xie, Andrij Usov (Fraunhofer) Christer Pursiainen (JRC) Andreas Burzel, Micheline Hounjet (Deltares) Amélie Grangeat, Dominique Sérafin, Mohamed Eid (CEA) Eric Luijf (TNO)

Security Assessment	**Rafal Kozik (UTP)**
Approval Date	10/07/2014
Remarks	No security issues found

The project CIPRNet has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 312450.

TABLE OF CONTENTS

TABLE OF FIGURES

1 Introduction

In CIPRNet, a demonstrator of a federated modelling, simulation and analysis (MS&A) tool for critical infrastructure protection (CIP) is being designed [DoW]. It will put into practice methodologies and technologies (tools, models, software and other components) developed by the different work packages of the project. The purposes of this deliverable are to present the results of an analysis of various European exercises of the civil protection and emergency services and, based on this analysis, to expose a cross-domain, cross-border simulation scenario considering external effects that could be run in the CIPRNet demonstrator. This application scenario is a transnational catastrophic event elaborated by the different participants of the 6th work package. The geographic location is across the Dutch-German border where the Rhine River flows. The German administrative area is the region of Kleve (Kreis Kleve / district of Kleve) and the Dutch administrative area is the region of Nijmegen (Stadsregio Arnhem Nijmegen). This area is a low-lying region protected by dikes along the rivers, thus a flood is obvious a potential threat. Due to climate change, extreme weather events like heavy rainfalls and therefore also severe floods are expected to become more frequent. Well-known floodings causing severe damages in the last twenty years include Rhine floods in 1993 and 1995, the Oder flood in 1997, flooding of several rivers, including Danube, Elbe, Oder in 2002 [Kirchbach1], and similarly in 2013 [Bayern1, BMLFUW1, CEDIM1, Sachsen1], and the flooding in Gloucestershire in 2007.

JRC collected experiences from European or international civil protection exercises and contributed its findings to the design of a cross-border scenario. The report can be found in Annex I. A strong emphasis was placed to flood-related exercises, but other types of threat scenarios were examined, such as earthquake, cyber-attack, pandemic, etc. The main sources were publically available reports describing the planning or evaluation of exercises. More specifically, the European Mechanism for Civil Protection is briefly described, as the majority of identified exercises simulate conditions that require the activation of this mechanism, requesting the deployment of intervention teams (including modules), teams of experts, national key contact point staff, officials of the Institutions and other intervention support. It became apparent that the scenarios should have a definite purpose. While the goal of CIPRNet scenarios varies from the goals of civil protection exercises, it is also important the scenario takes into account the expectations and priorities set by the end users.

CIPRNet scenarios have a strong emphasis on CIP and, therefore, they should clearly identify which critical infrastructures can be affected during the scenario. This was presented in most civil protection scenarios studied, even if it was not presented in a structured or detailed way. Out of the CI identified, several had additional importance as they can affect the outcome of the scenario, if they play a role in civil protection or in CI recovery. The scenarios should also depict dependencies between CI, cascading disruptions as well cross-border and cross-sector effects.

Several visual methods have been used in exercises in order to graphically present the civil protection scenarios. The scenarios vary in terms of complexity and this is reflected on the graphical tools used, which consequently vary in the level of abstraction, the level of detail, the points of interest depicted, as well as clarity. In most exercises, there was a high priority to present realistic scenarios, even in the cases where these were imaginary. Another key parameter examined is the effect of time on the scenario, as we observed various types of timelines, time intervals, phases, etc. The scenarios should also take into account or highlight potential difficulties in communication or cooperation between the CI operators affected, as the involved infrastructures may provide services to a neighbouring country, may be privately operated or may be highly complex to repair and recover.

In the following sections, the learnings from the civil protection scenarios are presented. The insights gained from studying the civil protection scenarios and exercises were implemented in the CIPRNet application scenario and the story lines, which are the most important contents of this deliverable. In order to prepare the elaboration of the storylines, it was necessary to gather comprehensive information on the area under consideration. This information will later be the basis for retrieving data for modelling the scenarios in computer simulation.

The document is organised as follows:

- First, in Section 2, the results of five exercises involving flooding as a threat are analysed providing several recommendations.
- As the application scenario is not limited to flooding as a threat, in Section 3, cyber crisis exercises have been studied and serve as complementary recommendations.
- Then, from Section 4 on, the focus is on the CIPRNet application scenario. It starts with a general definition and a description of the boundaries by answering a series of significant questions.
- In Section 5, the sectors involved in the scenario are listed and discussed. There are EU sectors and sectors defined at a national level which is then presented for Germany and the Netherlands.
- In Section 6, the main critical infrastructures are listed for the two regions of interest. The smaller elements of the different CI networks, which could play a key role when running the scenario in the demonstrator, are not listed directly. They are integrated into the demonstrator in specific GIS databases.
- In Section 7, the dependencies and the interdependencies of the main critical infrastructures are presented as well as the ones of the networks.
- Finally, two storylines with a limited number of fixed phases are described in the 8th Section. The final results of the scenario will be obviously be provided by the federated CIP simulator.
- A comprehensive study of civil protection scenarios and exercises is included as Annex I.
- Annexes II and III show additional work on integrating the gathered information in a Geographical Information System (GIS) and a Dutch specialty, a national risk map.

2 Insights from flood-related exercises within the EU

This chapter presents the results of five exercises, designed and performed within the EU, which share a relation to flooding. FloodEx 2009, Barents Rescue 2011 and Tanaris 2013 are examining scenarios of floods of a large magnitude, where in the case of FloodEx affect more than one country. Danubius 2006 describes the case of an earthquake, but some of the exercised field operations could also occur due to flood. Danex 2006 was also selected because it describes conditions of extreme weather and adds the element of man-made attacks taking advantage of a stressed situation in order to maximize the impact of the attack.

The table 1 that follows summarises basic information about the exercises, where the storylines of the exercises, as described in the identified sources, are presented with minor editing in Annex I. For each exercise, a ‘comments’ subsection was added in order to allow the reader to comprehend the specific characteristics of the exercise.

Table 1: Summary of the flood-related exercises. Legend: CPX: Command Post Exercise; TTX: Table Top Exercise; FE: Field Exercise

Exercise Name	Date, Place	Organiser	Participants	Threat Scenario	Exercise Type	Cross-boundary?	Sectors affected	Infrastructures involved	Sources
Danubius 2006	9-11 September 2006, Romania	National Committee for Emergency Situations (NCES), Romania	Austria, Bulgaria, Croatia, Germany, Hungary	Earthquake	CPX, FE	No	Chemical industry, Transport (Road), Water, Energy (distribution of oil)	Civil administration (emergency services), Health	Unknown
FloodEx 2009	22-25 September 2009, The Netherlands	Ministry of the Interior and Kingdom Relations, National Operations Centre, KLPD/LOCC	Estonia, Poland, Germany, United Kingdom, Netherlands	Natural Disaster: "Worst Credible Flood" in the North Sea area	CPX, FE	Yes	Transport (Road overload due to evacuation), Water	Civil administration (government functions, emergency services), Health, Transport, Water (Stemming and control of water quantity)	Based on (a) experiences of the flood in 1953 (casualties in UK and Netherlands), (b) the Dutch exercise 'Waterproef' and scenarios as 'Worst Credible Flood' and Evacuation in The Netherlands, (c) H19 in United Kingdom and (d) expert opinions.
Barents Rescue 2011	21-22 September 2011, Sweden	Swedish Civil Contingencies Agency	Norway, Sweden, Finland and Russia	Floods	TTX, CPX, FE	No	Energy, Water, Transport, Food, Public and Legal Order and Safety Information, Communication, Technologies, Health, Financial	Civil administration (government functions, emergency services), Health, Water	Based on fictitious incidents
Taranis 2013	27-29 June 2013, Austria	Austrian Red Cross Regional Branch of Salzburg	Bulgaria, Czech Republic, Croatia, Germany, Italy, Luxembourg, Romania	Floods	CPX, FE	No	Transport. Health, Chemical industry	Health, Civil administration (emergency services),	Unknown
Danex 2006	01 November 2006, eastern Denmark and southern Sweden	Danish Emergency Management Agency	Denmark, Sweden, Estonia, Germany, Hungary, Lithuania, Slovenia	Terrorist attacks combined with severe weather	FE	Yes	Transport, Energy, Health, Water, Indrustry	Health, Civil administration (emergency services),	Based on incidents which actually have occurred and, if they ever should occur simultaneously, would call for the need to activate the European Community Mechanism.

2.1 Recommendations and Findings

The exercises described are international in the sense that several Member States are participating as players to the exercise. In most cases though, the actual incident affects the geographical area of one country, which requests assistance. This assistance is provided by the involvement of the national civil protection operational point of contact and civil protection intervention team(s) [ECC1]. The cross-boundary effect of a scenario is increasing the complexity of the exercises, as it requires the coordination of operations across various countries and it exhausts available resources for international assistance. It also introduces additional communication problems. Communication and interoperability are identified as key factors in most exercises, even if these are limited within one region.

2.1.1 Affected infrastructures

While the emphasis is not placed on identifying the critical infrastructures affects, most exercises mention the effect of the scenario to key assets. This information is important for two reasons: (a) because infrastructure disruptions affect the population and modify the needs for evacuation, medical care or rescue (water contamination, power disruption etc.) and (b) because they may be needed as a resource by the command control and crews of the exercise. Therefore, it is also important to identify whether the centre of operations and the deployed teams have resources independent of the public and for how long they can maintain functions, without the need for resupplying.

One of the most important parameter to model in the CIPRNet scenario is the condition of the water-related defences, which can be considered as the immediate affected infrastructures. The type of damage or failure on these infrastructures can alter the scenario significantly as they alter the water flow but also the degree of damage it can cause. The CIPRNet team will examine whether the water simulation tools can provide such information regarding the impact of the flooding.

In the scenarios examined, several infrastructures were identified, which can face flood-related disruptions or random disruptions that augment the impact and complexity of the scenario. These dependencies will be part of the list for the modelling in Section 7. The flood-related disruptions identified are the following:

- Transport disruptions due to flood-related accidents (derailment, collision of road vehicles, collision of maritime vehicles, structural elements collapse or overflow, e.g. tunnels, bridges, airports etc.),
- Transport disruptions due to large scale evacuation of civilian causing traffic congestion,
- Disruptions of water supply or contamination of drinking water or other health hazards,
- Hazardous substances (CBRN) incidents due to structural damages/flooding on facilities,
- Hazardous substances (CBRN) incidents due to accidents to transporting vehicles,
- Collapse of sewage systems,
- Electrical power supply disruptions,
- Telecommunications disruptions,
- Medical care facilities disruptions, due to power shortage, flooding, absence of drinking water, increased number of patients or inability of the personnel or supplies to reach the location,
- Industrial or business disruptions, due to power or communication disruptions.

CIPRNet will model these disruptions with appropriate simulators and include events as defined in the storylines of the scenario. These can be accompanied by other types of events, such as natural disasters, accidents or man-made incidents that modify the availability of infrastructures and affect the simulation values.

2.1.2 Modelling of operations

The modelling of rescue or mitigation operations falls outside the scope of CIPRNet, but it would be important that in CIPRNet we examines ways to model where operations are actually taking place or the information required in order to monitor operations. It should be examined whether such information can be incorporated in the simulation tools, as it would interest the decision makers.

2.1.3 Degree of realism

Each scenario would be helpful if it is supported with historical data on previous, similar experiences in the area. Such sources can provide useful information on the impact of the scenario and whether critical infrastructures were affected. The scenario can also draw on similar experiences in neighbouring countries or regions. If such information is not available, other resources could include risk assessments that support the development of such a scenario in the specific region. However, since the CIPRNet scenario will be used in order to perform ‘what-if’ analysis, the examination of unprecedented or unlikely events or complex scenarios (like the Danex combination of incidents) may also provide useful insight to decision makers, especially in terms of resources and critical infrastructure resilience.

2.1.4 Availability of resources

A parameter examined in several scenarios is the introduction of conditions where resources are already stressed or exhausted from previous incidents. Such incidents can be of similar nature but of a smaller scale (smaller scale floods, other incidents caused by the severe weather) or unrelated incidents in neighbouring regions (such as fire accidents, man-made attacks, etc.). In the case of CIPRNet, two alternative, but similar storylines can be simulated, where the difference lies on the availability of key resources in a specific point in time.

2.1.5 Visual representation

Most scenarios were supported by maps and screenshots of various phases of the flooding incident. In some cases, the maps were limited, difficult to comprehend or read and with limited explanation. In CIPRNet, we will aim for clear and comprehensive visualisations, as this will enable to demonstrate clearly the storyline and simulation results of the scenario. In the flood-related cases examined, the reports did not indicate the usage of a specific visualisation tool, so requirements defined by the decision makers remain unclear.

However, visual maps were utilised in order to demonstrate the development of the flood in 2-D maps. Such visualisations can depict a screenshot of the scenario on each day of the simulation, marking affected infrastructures and other points of interest, as well. For example, in most EU exercises the field exercise areas and the Centre of Operations are also marked clearly on the map. In the case of CIPRNet specific areas of interest can demonstrate areas where manned teams are needed for search and rescue, for repairing key infrastructures, for managing water flow (installation of water pumps) and so on.

2.1.6 Timeline

In several cases, the timeline of events remained unclear and time periods were mixed. It would be useful if textual and graphical representation is used in order to describe the situation (level of water, state of operation on key infrastructures, location of deployed teams etc.) for specific, clear and district points of time, similarly to the Barents exercise but in a more structured way.

The scenarios can start from prognosis or alert signs, several days before the actual initiating event occurs. In some cases, preceding events of previous months were described, such as in the Danubius case. The selection of the day zero of the scenario can vary from the EU exercises' descriptions, as it is usually marked by the activation of the mechanism for requesting international assistance. Important points of time are major changes in the water elements (such as breaches or overflows) or when something changes on the development of scenario, e.g. changes in weather conditions, man-made incidents or infrastructure disruptions.

The time of occurrence can also alter significantly the outcome of a scenario. These parameters need to be taken into account:

- whether the event occurs during the day or night,
- whether the event occurs in summer or winter,
- whether there is an event in the area that increases the population (e.g. a festival, conference or convention), and
- whether the most vulnerable individuals or communities were evacuated effectively before the event.

In Section 3 of the Annex I, several examples of graphical representations of the scenario timeline are given.

3 Insights from cyber crisis exercises

On 4 October 2012, more than 500 cyber-security professionals participated in Cyber Europe 2012, the second pan-European Cyber Exercise [ENISA1]. The exercise aimed at improving resilience of critical information infrastructures in terms of cyber-crisis cooperation, preparedness and response across Europe. The exercise highlighted the need for communication between public and private players, so a realistic scenario should reflect the interaction and decision-making needed both by public and private CI operators. The exercise also identified that public–private cooperation structures differ from country to country, so the selection of varying cases or models of cooperation between the different scenarios could be interesting. Challenges were identified in the operational procedures, notably in terms of scalability due to the large number of playing countries and institutions. As an analogy it would be useful if the scenarios have a varied level of complexity, so as to identify the point where the use of the modelling capabilities poses limitations or on the contrary helps decision makers to overcome this obstacle.

One of the goals of CyberEurope 2012 was to test international cooperation and, thus, many bilateral and multilateral interactions at the international level took place. If the designed scenarios identify such international dependencies in between infrastructures it would be an added value, as it can demonstrate the value of the simulation capabilities of CIPRNet. The exercise also identified that procedures and information flows proved to be crucial for building a fast and effective response capability across Europe. In the case of CIPRNet, the modelling of dependencies between infrastructures will indicate points of information flow required between different infrastructures. The exercise also highlighted the need to explore inter-sectoral dependencies, which is already the character of the scenarios under design. In CIPRNet the design is based on the functions connecting and interconnecting the CI (Section 7).

The Table Top exercise CIP-CEP focused on Critical Infrastructure Protection and was held in Sofia, Bulgaria [Luiijf1]. The scenario concerns three imaginary nations, out of which two are NATO members. This exercise examined the effect of CI disruptions and highlighted that the participants in such exercises share different levels of CIP expertise, which is a parameter that one needs to take into account when designing CIP decisions tools (and their respective scenarios). The exercise was organised in a way that allowed the participants to recognise the existence of CI and their dependencies at the beginning and then examine the international or cross-sectorial dimension of them, which is similar to the priorities identified by Cyber Europe 2012.

In terms of methods used to developing scenarios, the approach used in the previous exercise identifies as important to:

- clearly define the exercise,
- define the abstraction level (e.g., national/regional, management/technical),
- define the environment (real or fictive world),
- select the CI to be involved,
- identify involved stakeholders (participants),
- select the type of threat(s),
- select the type of script (describe the series of events – incident evolution),
- determine the location and the available time,
- select supporting tools and
- check participants' background knowledge.

4 CIPRNet application scenario definition

The protection and the modelling of critical scenarios have been used for decades in military trainings [Smith1]. Scenarios and the corresponding exercises are powerful tools and inputs for decision makers in charge of the risk management of any structure. Many general principles have been established [Heijden1] which could be reused for the protection of critical infrastructures. The methodology to build valuable scenarios is important to actually reach our goals. In CIPRNet, the "story and simulation" approach has been used [EEA1], our group of experts started by establishing qualitative storylines and in parallel the models to run the scenario have been identified. The databases needed to feed each model have been identified and actions are on-going to gather them all. The composition of a scenario is an iterative process; additional iterations will take place during the realisation phase of the complete simulator after this deliverable. The scenario presented in this document is the results of a constrained number of interactions within the CIPRNet consortium and local decision makers. However, the contents allow initiating the modelling of the federated CIP MS&A. The structure of the scenario was composed with the recommendations of Section 2 and Section 3 and additionally with the recommendations of W.J. Tolone et al. [ICCIP1] to get an effective scenario and the revelation of blind spots in CIP planning. In all the process the expertise of the different stakeholders contributed to the scenario.

4.1 Purpose of the scenario

The scenario is designed to feed the CIPRNet federated simulator of CI-systems that is developed to offer CI end-users the capability to perform "what if" analysis. Emergency managers could use such a capability to evaluate the vulnerability of their systems, to plan effectively evacuations or to reinforce their systems. CI are more and more interconnected and the consequences of a disruption of a CI may have strong cascading effects on others CI which may even be further located [Rinaldi1]. Those cascading effects are difficult to identify without any powerful tool. A better modelling of the dependencies and interdependencies (see section 5) in a federated simulator should reveal such cascading effect. The federated simulation system of CIPRNet is inspired from the DIESIS project were four simulators were integrated [Rome1, DIESIS1]. More simulators will be integrated as explained in Section 3 before to show the interlaying effects between the different critical networks.

4.2 Scope of the scenario

4.2.1 Geographical localisation and restriction

The geographical location is restricted to the Kleve district in Germany and the city region of Arnhem-Nijmegen in the Netherlands. The three main cities concerned are Nijmegen (NL), Kleve (DE) and Emmerich am Rhein (DE). The Rhine runs through those two regions, the cities of Nijmegen and Emmerich am Rhein are along the river and both cities are very close to the border. The map in Figure 1 shows wide river winter beds near the two regions of interest but the exact borders do not correspond to the Kleve district and the city region of Arnhem-Nijmegen.

Figure 1: River maps across the German and Dutch Border in the regions of Kleve and Arnhem-Nijmegen. The region contains 56 river communities (Dutch: Riviergemeenten; German: Flussgemeinden). (Source: Kreis Wesel, Germany)

The Kleve district (Kreis Kleve) is a local government district in the North Rhine-Westphalia Land, Germany. The total area of the district is 1,232.15 km^2 and the population at the end of

2012 was 301,977 inhabitants (source wikipedia.org). Population density in 2011 was 250 inhabitants per square kilometre (source: German Federal Statistical Office). In Figure 2, the localisation of the district in Germany and a second map with the different municipalities are presented.

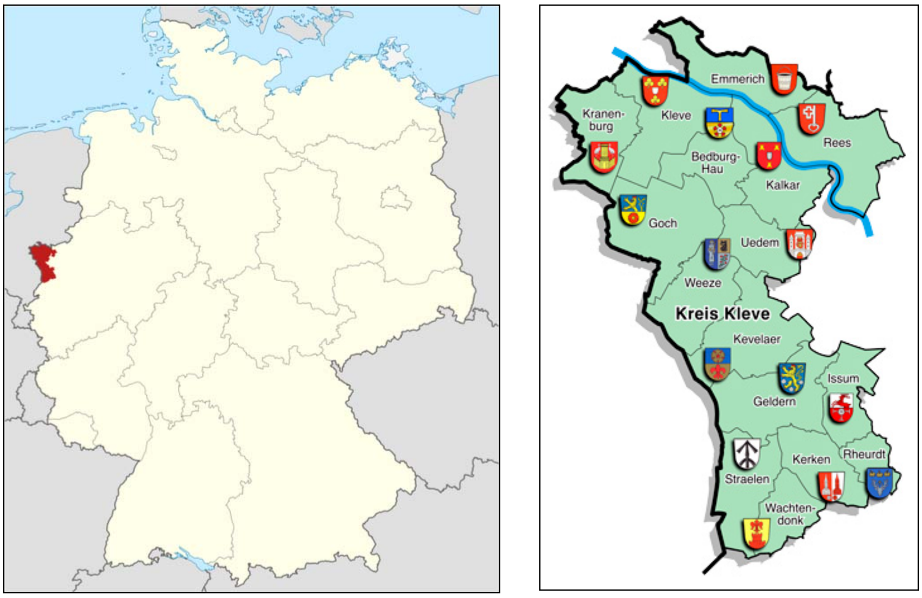


Figure 2: Maps of the Kleve district in Germany. (Sources: Wikipedia.org and feuerwehr-kellen.de)

The "city-region" of Arnhem-Nijmegen is a metropolitan area with two large cities of Nijmegen with 168,499 inhabitants (in 2011) and Arnhem with 150,959 inhabitants (in 2011). Additionally 18 smaller municipalities complete the metropolitan area. Based on the statistics of the 2011, 736,107 people are living in these municipalities covering ~1,000 km² (Source: www.arnhemnijmegencityregion.nl).

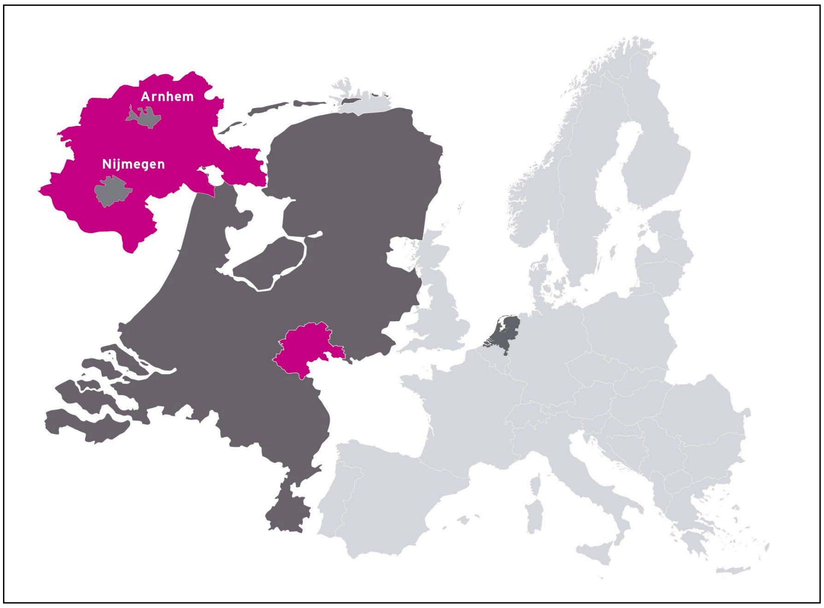


Figure 3: General map of city region of Arnhem-Nijmegen in the Netherlands. (Source: www.arnhemnijmegencityregion.nl)

4.2.2 Time of the scenario

For the different storylines proposed in Section 8, the time of the scenario is limited to a couple of days and the simulation will run few hours after the last event or few hours after the maximum impact is reached. The time for the recovery phase, which can be much longer is in purpose not included. For the modelling, the time is crucial because the different simulator have different time and execution models [Rome1]. Simulators may run until a steady state, until it reaches a state where an interaction is needed (discrete events) or simulators may run with constant time steps or close to real time with short time steps.

4.2.3 Participating phenomenon

The application scenario will involve three different threats in the three different storylines that are proposed in Section 3. The first storyline involves the phenomena of intense rainfall and flooding initiated by two breaches in the dikes. The second storyline is centred on a railway accident with air and water pollution. The phases of the different storylines are feeding the same scenario and using the same federated simulator.

4.2.4 Availability of resources

The availability of the resources can have strong consequences in the running of a civil protection exercise. As mentioned in Section 2.1.4, this can become a parameter to include or not in a scenario. At this stage of the project, the focus is more on the demonstration of the interdependencies between the CI, thus this parameter is not part of the two first storylines proposed in this report. However, because of its significance the availability of the resources can be introduced in new storylines feeding the federated simulator.

4.2.5 Involved stakeholders

In this section, we list the major stakeholders located in the area covered by the Dutch-German cross-border scenario. Wherever possible with certainty, we will mention some of them in the storylines of the application scenarios. Meetings with stakeholders are planned in order to validate our storylines. This document may receive an update after that step, depending on the contributions of the stakeholders.

Table 2: Major stakeholders in the German district of Kleve

Stakeholder type	Stakeholder	Description / sector
District Kleve	Regional civil protection / emergency management	Emergency management
Safety & security Kleve	Local emergency management (city administration)	Emergency management
	Feuerwehr (fire-fighters)	Mostly voluntary fire-fighters
	Technisches Hilfswerk (THW) Kleve Ortsverband	German technical organisation for search and rescue, regional subsidiary
City of Kleve	Stadtwerke Kleve	90% of the residents of Kleve are customers of that supplier of gas, electricity and drinking water. They also operate a ferry, parking garages, public swimming pools, and an electro-mobility infrastructure.
	ExtraEnergie GmbH	Electricity
City of Emmerich	Stadtwerke Emmerich	Electricity

Stakeholder type	Stakeholder	Description / sector
	ExtraEnergie GmbH	Electricity
City of Rees	RWE Vertrieb	Electricity
	ExtraEnergie GmbH	Electricity
Transport CI operators	Verkehrsverbund Rhein-Ruhr (VRR)	Local and regional public transport
	Deutsche Bahn: DB Regio and DB Fernverkehr; Eurobahn (ERB)	Rail public transport
	DB Schenker Rail Deutschland	Rail cargo transport
	DB Netz	Rail / track network
Logistics	Deutsche Post DHL, FedEx	Mail & packages delivery services, supply chain
Telecommunication	Telekom, Vodafone, Unitymedia, O2, 1 & 1	Fixed line and mobile communication, cable TV, Internet access

In the Netherlands, the regional protection is coordinated by so called Safety-Regions (Veiligheidsregios, cf. Figure 4). Furthermore, the regional water boards (Waterschappen) are responsible for the management of water-related issues, such as flood protection and flood defence measures.

It is proposed to involve the Safety Region of Noord- en Oost-Gelderland in a later phase of CIPRNet in order to look into this storyline scenario and to provide us with information, what a Safety Region would do in this situation and what types of information they would use.

Table 3: Stakeholders in the region of Nijmegen

Stakeholder type	Stakeholder	Description
District Nijmegen	Regional civil protection / emergency management, Veiligheidsregios	
CI operators	Railway: - ProRail (Track network owner) - Nederlandse Spoorwegen (national operator) - Veolia Transport (regional operator)	
	National Electricty Network - High Voltage: Tennet - Medium and Low Voltage: Continoun	
Veiligheidsregios	- Noord- en Oost-Gelderland - Gelderland-Midden - Gelderland-Zuid - Braband-Noord	
Water Boards	- Waterschap Rijn en IJssel - Waterschap Rivierenland	

Figure 4: "Veiligheidsregios" at the Dutch-German border (Source: Deltaportaal.nl)

5 CI sectors involved in the scenario

5.1 CI sectors defined by the European Commission

It is difficult to delimit the different sectors that contain CI or vital infrastructure services. The EU member states have also slightly different perspectives. In help of the convergence, the European Commission proposed in 2006 a common list of CI sectors and subsectors [CDP787]. This list is reproduced in Table 4. The different European Member States do have not exactly the same list. The CI sector list for Germany is described in Section 5.2 and the one for the Netherlands in Section 8.

Table 4: Critical Infrastructure sectors as identified in [CDP787]

Sector	Subsector
I Energy	1 Oil and gas production, refining, treatment, storage and distribution by pipelines
	2 Electricity generation and transmission
II Nuclear industry	3 Production and storage/processing of nuclear substances
III Information, Communication Technologies, ICT	4 Information system and network protection
	5 Instrumentation automation and control systems (SCADA etc.)
	6 Internet
	7 Provision of fixed telecommunications
	8 Provision of mobile telecommunications
	9 Radio communication and navigation
	10 Satellite communication
	11 Broadcasting
IV Water	12 Provision of drinking water
	13 Control of water quality
	14 Stemming and control of water quantity
V Food	15 Provision of food and safeguarding food safety and security
VI Health	16 Medical and hospital care

	17 Medicines, serums, vaccines and pharmaceuticals
	18 Bio-laboratories and bio-agents
VII Financial	**19 Payment and securities clearing and settlement infra-structures and systems**
	20 Regulated markets
VIII Transport	**21 Road transport**
	22 Rail transport
	23 Air transport
	24 Inland waterways transport
	25 Ocean and short-sea shipping
IX Chemical industry	**26 Production and storage/processing of chemical sub-stances**
	27 Pipelines of dangerous goods (chemical substances)
X Space	**28 Space**
XI Research facilities	**29 Research facilities**

In 2008, the EU defined European Critical Infrastructure (ECI) and a few criteria for their identification in a Council Directive [CD114]. A CI localised in one of the member states for which the disruption or destruction would have a significant impact on at least two member states is an ECI. The ECI sectors were limited to energy and transport, and Member States were requested to identify their ECI. However, the process is on-going and current results are not promising. Therefore, for our scenario definitions, the current national definitions of CI in The Netherlands and Germany are more relevant.

5.2 CI sectors in Germany

The nine German CI sectors are listed in Table 4. Compared to the EU proposal in Table 5, it can be noticed that the following proposed CI sectors are not incorporated: "Nuclear industry", "Chemical industry", "Space", and "Research facilities". On the other hand, Germany identifies two more CI sectors, namely "State and administration" and "Media and culture".

Table 5 CI sectors in Germany (source: German BBK)

German Sectors	Translated German Sectors
1. Energie	Energy
2. Transport & Verkehr	Transport and traffic
3. IKT	ICT
4. Staat & Verwaltung	State and administration
5. Medien & Kultur	Media and culture
6. Wasser	Drinking Water
7. Ernährung	Food
8. Finanz- & Versicherungswesen	Finance and insurance
9. Gesundheit	Health

5.3 CI-sectors in the Netherlands

The Dutch CI-sectors are listed in Table 6. It was used as the basis for the 2005 EU CI-sectors proposal with additionally a specific sector that is the "Surface water management". Water management in the Netherlands has a long history with the creation of polders and the construction of kilometres of dikes. This is a specific CI sector for the Netherlands because of its geography.

Table 6 CI sectors in the Netherlands (www.government.nl)

Dutch Sectors	More information
1. Energy	Electricity, natural gas and oil
2. Telecommunications and ICT	Land-line and mobile telephony, radio, broadcasting and the internet
3. Drinking water	The water supply
4. Food	The food supply (including in supermarkets) and food safety
5. Health	Emergency and hospital care, medicines, vaccines & isotopes
6. Financial sector	Payments and money transfers by public bodies
7. Surface water management	Water quality and quantity (control and management)
8. Public order and safety	Maintaining public order and safety
9. Legal order	The courts and prisons; law enforcement
10. Public administration	Diplomacy, public information, the armed forces, decision-making
11. Transport	Amsterdam Schiphol Airport, the port of Rotterdam, highways, waterways, railways
12. Chemical and nuclear industries	The transport, storage, production and processing of hazardous materials

5.4 CI-sectors involved in the CIPRNet modelling

In CIPRNet, the goal is to federate a large number of simulators to demonstrate the complexity and to illustrate the consequences of the dependencies between the CI. For the modelling, the CI systems present in the areas covered by the scenarios and which are relevant for the identified storylines will be modelled. The degree of simulation can be different between the different CI. In the case of an electricity disruption, the federated-simulation can provide in GIS maps the status of electrical network and the information that for example an hospital, which is a CI, will be impacted but with no further details on the level of operability in this hospital. The external cause or the threat needs to be modelled in the federated simulation. In our consortium, a flooding, which impact large areas, can be simulated with advanced simulation tools providing high degree of realism. Such results coupled into federated-simulator are ideal to reveal the consequences on CI from different sectors and even in two different countries. In the DIESIS project, the electrical power transmission, the telecommunication and a simulator for natural external events were integrated. In the actual scenario, the model is extended. More details on the design of the federated simulation can be found in the deliverable D6.1 of the project and forthcoming deliverables on the realisation of the “what if” analysis capability.

6 (Critical) Infrastructures overview

The geographical area of the scenario (Section 4.2.1) contains many infrastructures. Some of them may be critical, some not. The amount of information which can be used in the CIPRNet simulator cannot be listed directly in this deliverable. The information is thus stored in various Geographic Information System (GIS) databases (see Annex II). In a GIS database, the specific data regarding a network of CI is stored with the geospatial data. Each simulator of the federated simulation will store, query and manipulate the geographical information of its own database. The link will be done by the CIPRNet middleware [Rome1]. Using the visualisation functions of a GIS, the different networks can be represented on maps by layers (Figure 5: QGIS as an example).

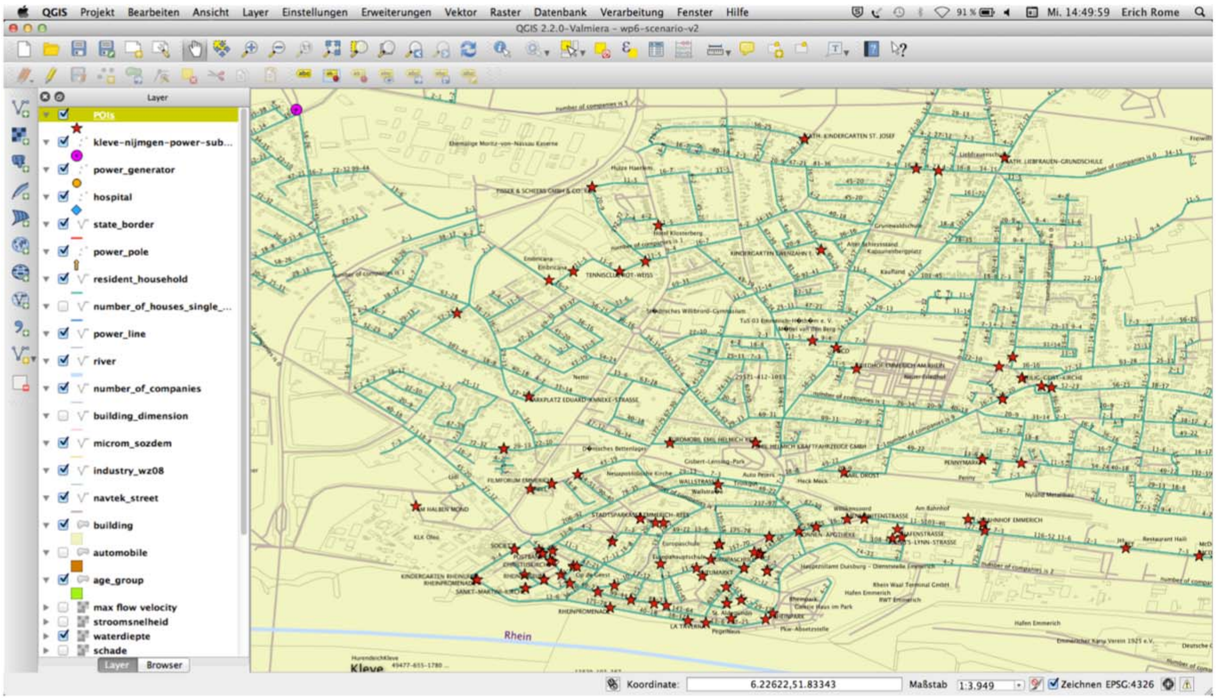


Figure 5: Screenshot of QGIS (Quantum GIS, www.qgis.org) software, showing a map of the city of Emmerich, with streets, points of interest (red stars), and socio-demographic data at street segment level (number ranges at the blue marked streets).

In this section, we will merely provide an overview of those infrastructures that form important elements of the scenario. In the Netherlands, selected CI and related natural hazards such as flooding are listed at the interactive risk map (risicokaart) available at risicokaart.nl (see also Annex III).

6.1 Electricity network

Many nodes of the electricity network are CI elements and few large high voltage transformers are even ECI elements. Electricity infrastructure mainly consists of power generation infrastructure, such as conventional, nuclear and renewable energy power plants, and electricity networks such as high voltage transport network infrastructure, middle voltage transport and low voltage distribution networks. All these infrastructure elements (except nuclear power plants) are also present in the area under consideration. From the available maps (see next sections) it seems that there are no direct cross-border interconnections in the scenario area. However, on a larger scale, the electricity networks in Europe are indeed interconnected and may be subject to cascading cross-border effects.

6.1.1 German electricity networks and generation elements

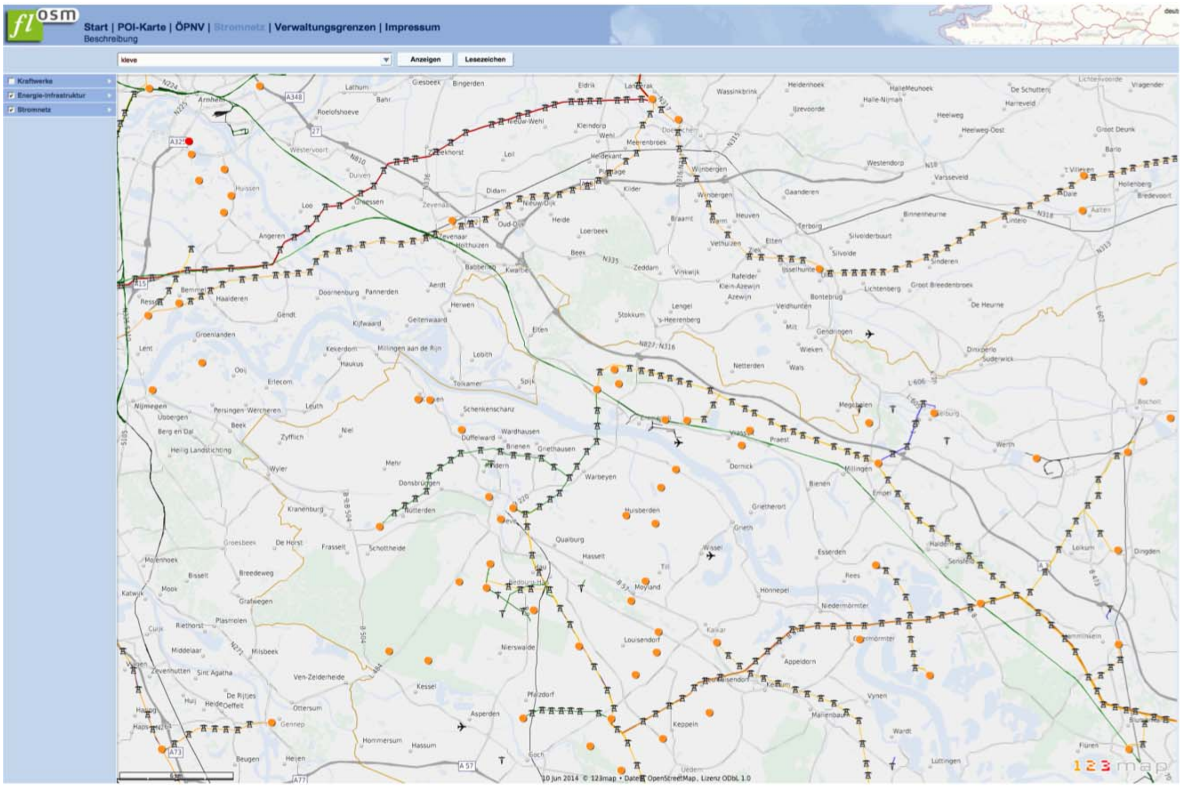


Figure 6: Electricity networks in the district of Kleve: Powerpoles (grey icons), transmission lines (yellow, red and green lines), power plants (orange and red dots) (source: flOSM).

6.1.2 Dutch electricity networks

Figure 7: Electricity networks in the area around the Dutch city of Nijmegen. Coloured lines: Transmission networks. Red: 380 kV; blue: 150 kV; yellow: 50 kV.

6.2 Gas pipeline

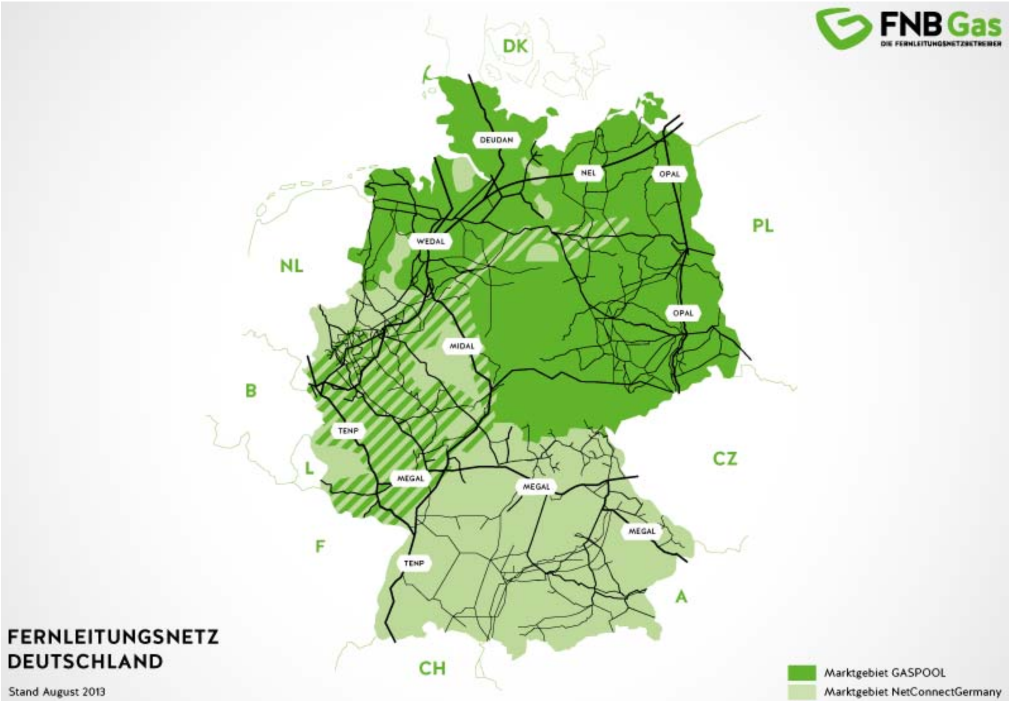


Figure 8: Map of gas pipelines (black) in Germany. One such pipeline runs through the district of Kleve (source: FNB Gas e.V. http://www.fnb-gas.de/de/fernleitungsnetze/fernleitungsnetze.html).

6.3 Road network

The road network in the study area is characterised by the major European highway E35 (Dutch: Snelweg/Rijksweg A12, German: Autobahn A3) between Germany and the Netherlands (Figure 9). On average, 30.000 cars cross the Dutch-German border each day.

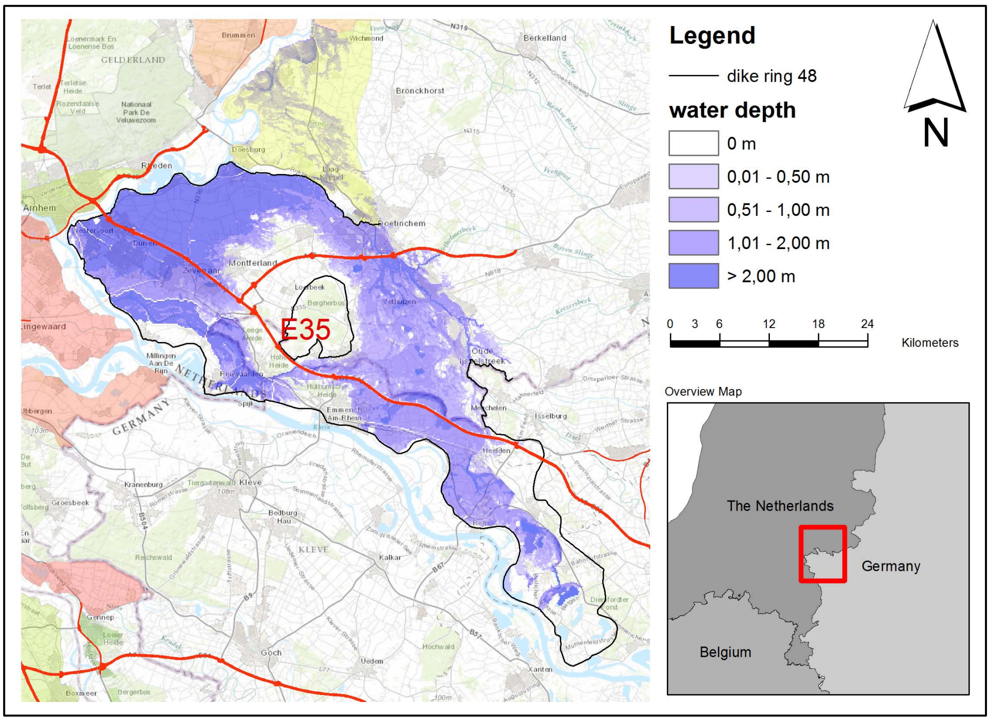


Figure 9: Course of the E35 highway (red) within dike ring 48, potentially heavily affected by a flood event (source: [Burzel1], based on flood scenarios provided by the Dutch water boards).

6.4 Railways network

6.4.1 Overview of the lines

6.4.1.1 Netherlands

The Dutch railway system covers more than 6800 km of tracks, mostly electrified and with two or more tracks. The system is seen as one of the most complex and dense operated railway systems worldwide, with many relations to the neighbouring countries Germany, Belgium and France. From 2003, the owner of the network is ProRail, while the service is performed by Nederlands Spoorwegen (NS) and regional carriers (Figure 10).

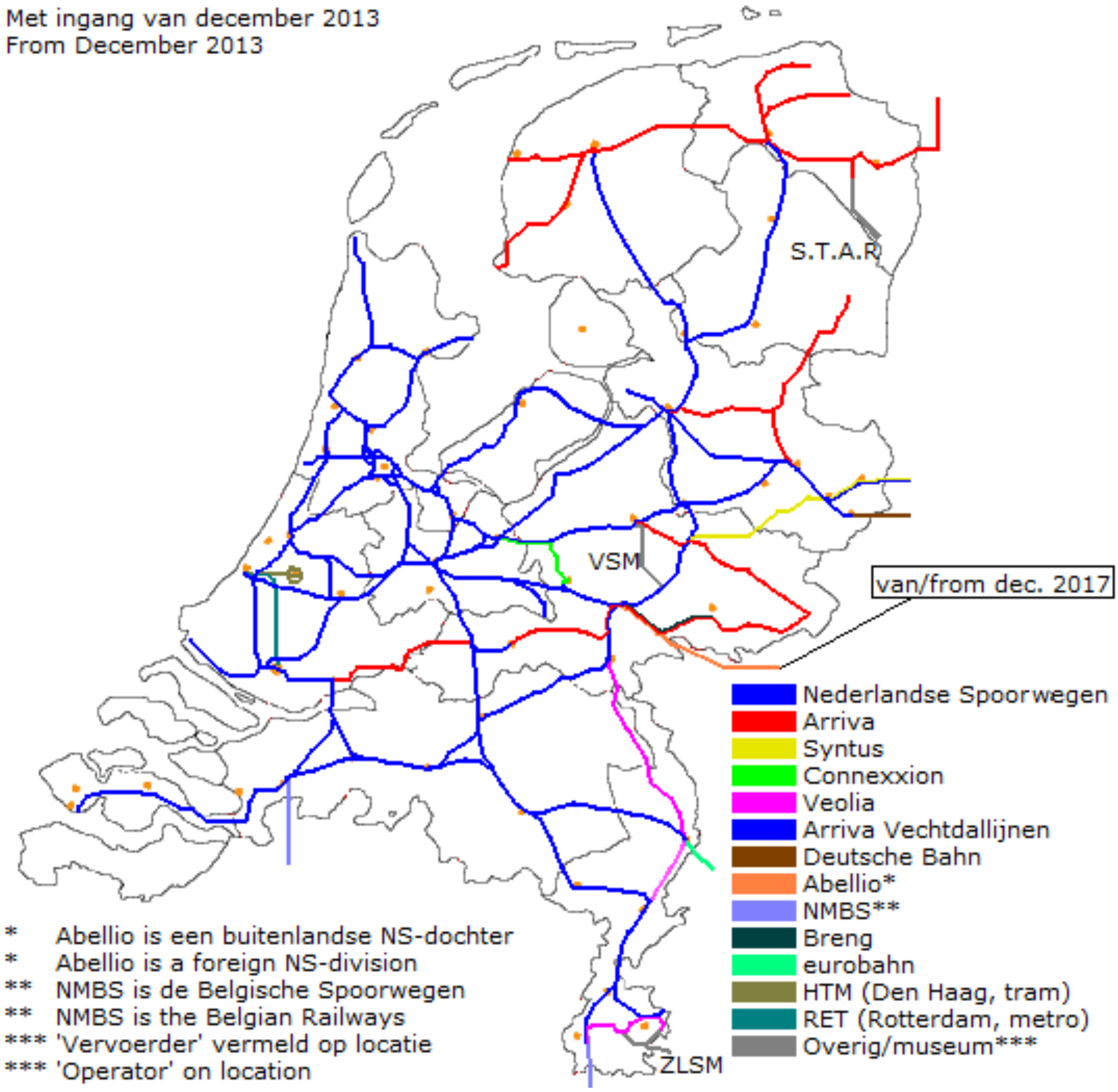


Figure 10: Railway network in the Netherlands, including the local operators on the relations (source: wikipedia.nl)

6.4.1.2 Germany

Three railway lines run through the district of Kleve. Two of these lines end in the cities of Kleve and Xanten and carry mostly regional public transport and cargo.

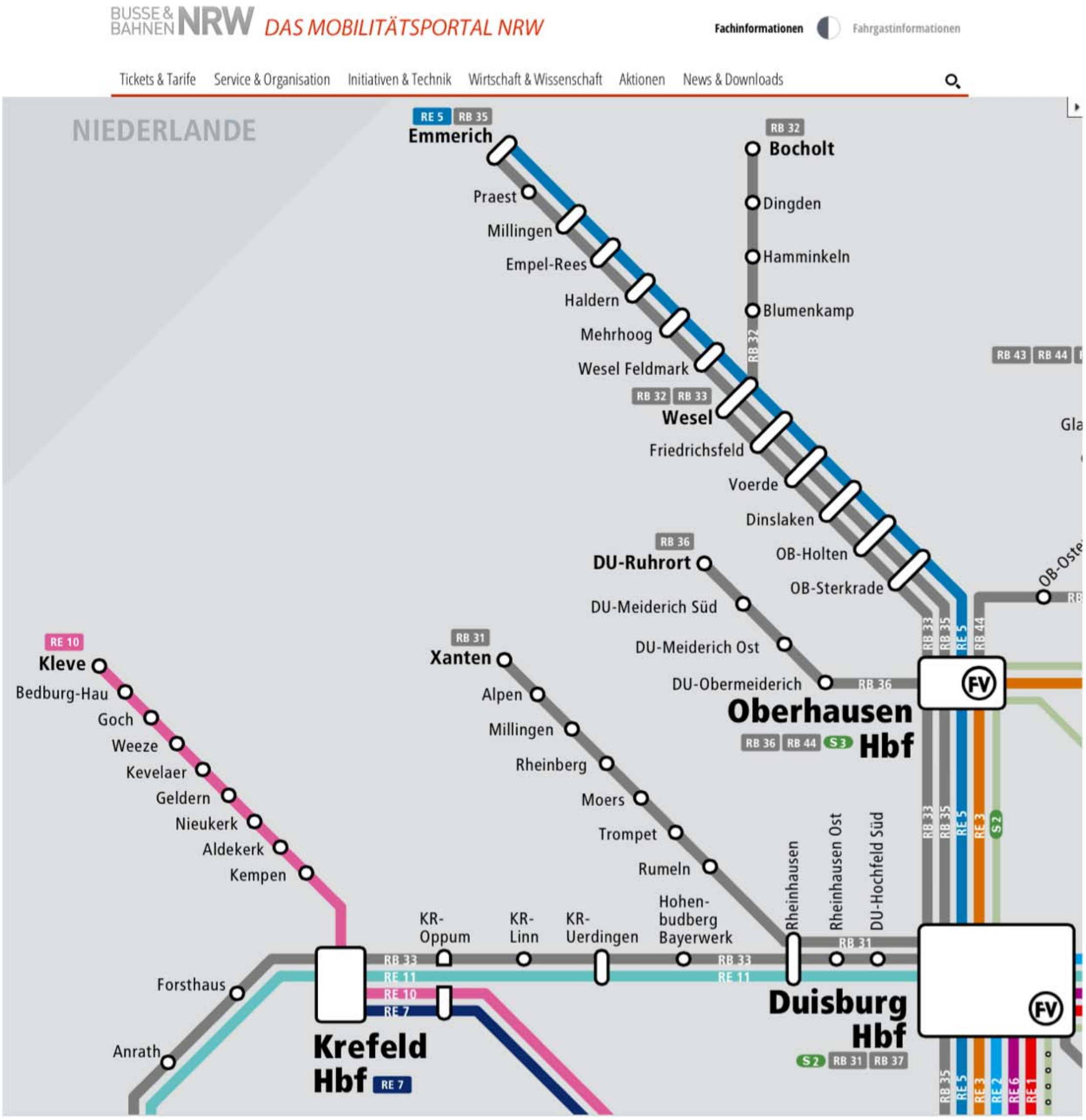


Figure 11: German railway networks and stations in the district of Kleve (source: Mobilitätsportal NRW)

The most important railway track in the region of interest is an international track belonging to the so-called Rhine-Alps corridor. Major lines operating on this track are the Betuwe route (cargo; see next paragraph) and an InterCity Express (ICE) train connection between Amsterdam and Germany (public transport). The ICE high-speed train traveling at speeds of up to 300 km/h is operated by the Deutsche Bahn (DB). All ICE trains from Amsterdam to Köln, Frankfurt/Main and Basel pass through Emmerich am Rhein without stopping.

6.4.2 Betuwe route

The Betuwe route is a double track freight railway from Rotterdam to Zevenaar, with extensions to Germany and the European hinterland (Rhine-Alps corridor of the railway network). It is an ECI as since 2011, nearly 80% of all freight trains between Rotterdam and the Dutch-German border took the Betuwe route. From 2009, 6.000 tons of iron per day are transported between Rotterdam port and Dillingen in Germany using cargo trains on the Betuwe route. The traffic volume of the Betuwe route within the district of Kleve is in the order of 35.000–50.000 trains per year (equivalent to an average volume of 96–136 trains per day or 4-6 trains per hour).

Figure 12: Map of the Betuwe route in the Netherlands. (Source: Benelux railways web site)

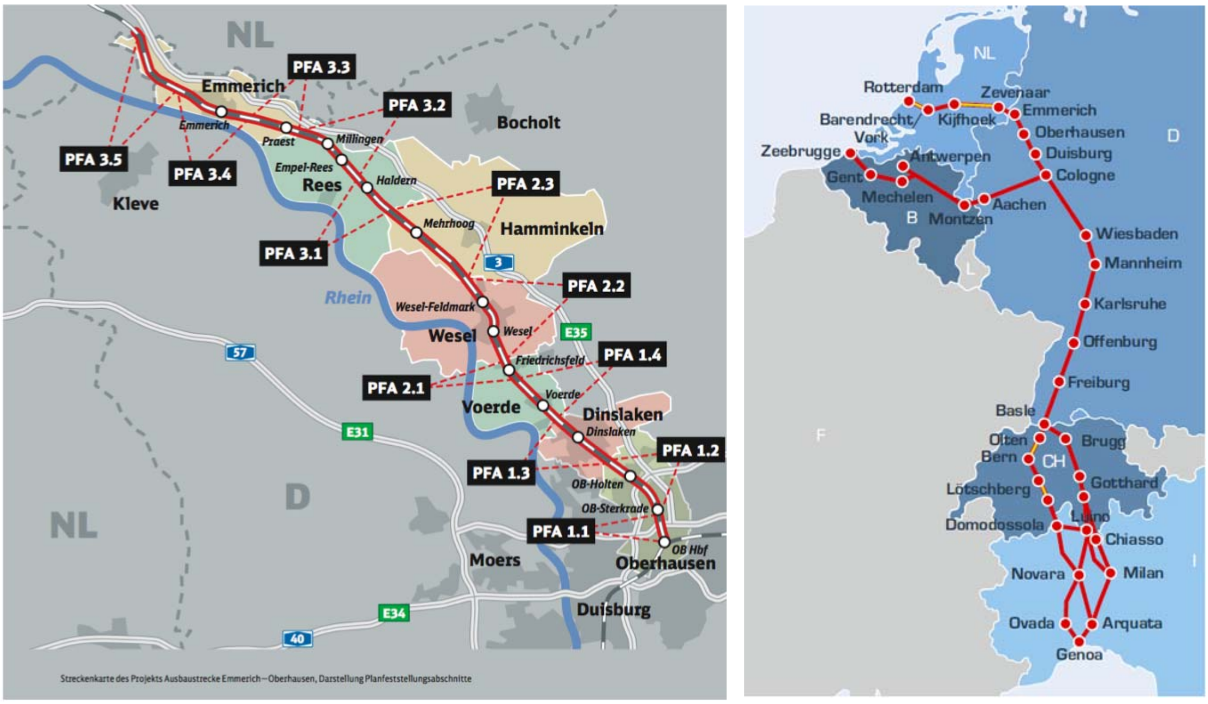


Figure 13: Extension of Betuwe route in Germany and plans for future development near Kleve (left, source: http://www.voerde.de/betuwe) and map of the most important rail corridor (Rhine-Alps corridor, right, source: DB Schenker, http://www.dbschenker.com/ho-en/news_media/press/news/2226778/european_corridor.html?start=55&itemsPerPage=50)

Within the area of the scenario, there is the "Spoortunnel Pannerdensch Kanaal" which is the tunnel under the Pannerdensch channel between Bemmel and Zevenaar (Figure 14). More details on the design of the tunnel can be found in [Heijmans1].

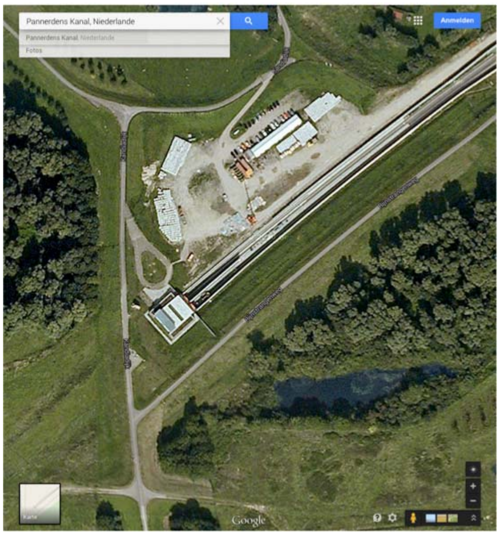


Figure 14: Picture of the East entrance of the Pannerdensch channel railway tunnel near Zevenaar in the Netherlands (source: Google Maps).

6.5 Rivers, dikes and harbours

6.5.1 Rivers and other waters

The Rhine is the major river in the scenario area and the most important German inland waterway. It carries 85% of German inland waterways traffic. Shortly after the Rhine crosses the Dutch-German border, it splits into two arms: the Lek and the Waal. On the Dutch side, the river Meuse goes along the Dutch-German borderline and merges with the Waal arm of the Rhine in the city of Nijmegen. The whole area of the Kleve district is intervened by brooks, creeks and lakes. Most of the latter are remains of older arms of the Rhine and are therefore prone to flooding.

6.5.2 Dikes

Control and protection of river dikes is organised both in the Netherlands and Germany in so-called dike ring regions (Dutch: dijkring; German: Deichkreis). Figure 15 shows the dike ring regions in the Netherlands and in the district of Kleve and its close vicinity. The dike rings relevant for our scenario are numbered 41 (Dutch), 42 (German), 43 (Dutch), 48 (German).

6.5.3 Harbours

The German city of Emmerich provides an inland harbour at the river Rhine. The city constitutes a so-called trimodal terminal (waterway, rail, street)[1].

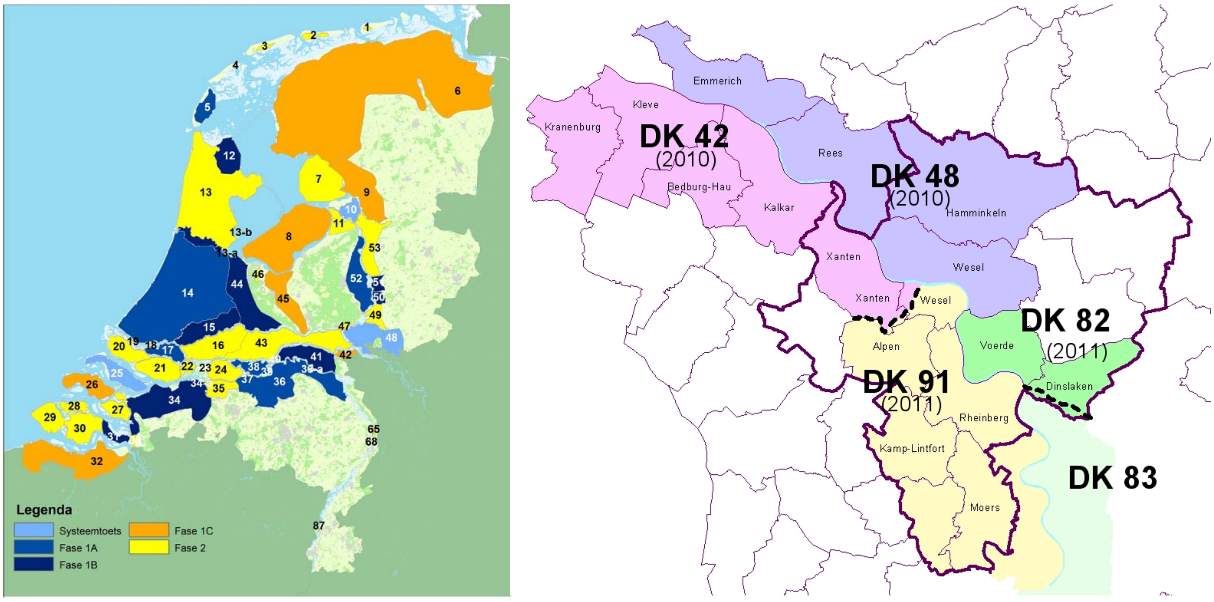


Figure 15: Dike rings in the Netherlands (left, source: http://www.helpdeskwater.nl/onderwerpen/waterveiligheid/programma'-projecten/veiligheid-nederland/planning/) and in the district of Kleve. (right, source Viking project)

6.6 Health-related CI

The health systems won't be completely simulated but the CIPRNet federated simulation can provide the information that a hospital is impacted; this information is relevant to the end users who can know with local crisis exercises what could be the state for the different services of a particular hospital and the organisation of evacuation. In the area of interest, the following list of hospitals has been identified.

[1] Source: Studiengesellschaft für den Kombinierten Verkehr e.V. (SGKV)

Table 7: List of hospital in the region of Kleve and Nijmegen

City	Name and information
Nijmegen (NL)	Ziekenhuis Canisius Wilhemina (653 Beds), close to one Rhein channel
	Radboud University Nijmegen Medical Centre, 953 beds, in higher altitude
Emmerich am Rhein (DE)	Sankt Willibrord-Spital Emmerich-Rees, 293 beds
Kleve (DE)	St.-Antonius-Hospital, 367 beds
Bedburg-Hau (DE)	LVR-Klinik Bedburg-Hau, 950 beds, http://www.klinik-bedburg-hau.lvr.de
Kalkar (DE)	St. Nikolaus-Hospital, 96 beds, http://www.kkikk.de/snh/
Goch (DE)	Wilhelm-Anton-Hospital, 223 beds, http://www.kkikk.de/wah/index.html
Kevelaer (DE)	Marienhospital, 218 beds, http://www.de.kkikk.de/mhk/index.html
Xanten (DE)	Sankt Josef-Hospital, 163 beds, http://www.sankt-josef-hospital.de
Geldern (DE)	St.-Clemens-Hospital, 312 beds, http://www.clemens-hospital.de

6.7 Communication networks

6.7.1 German communication networks

District of Kleve contains mobile and landline telecommunication infrastructures that are typical for West-German urban areas. Landline digital and voice communication services are provided by several large TelCo companies, in particular, Telekom, Vodafone, Unitymedia, 1&1, Versatel, congstar, TELE2 and O2. The topology of the landline telecommunication networks (mostly but not exclusively owned by Telekom) is not publically available.

Mobile communication networks are represented by Vodafone, Telekom, E-Plus and O2 (there are also several providers without own infrastructure). Depending on the area, GSM, UMTS, 3G and 4G services are available. The network covering information is available separately for different companies at:

- Vodafone: http://www.vodafone.de/privat/hilfe-support/netzabdeckung.html
- O2: http://www.o2online.de/microsite/o2-netz/netzabdeckung
- E-Plus: http://geoinfo.eplus.de/evinternet
- Telekom: http://www.t-mobile.de/netzausbau

According to the decree on the procedure of providing evidence for the limitation of electromagnetic fields (issued in 2003), German Federal Network Agency (Bundesnetzagentur) must be informed about positions and technical information of all transmitters having transmitting power above 10W. This information is published on the Web[2] (see Figure 16). Following information is provided:

- Geographic position
- Antenna type
- Mounting height above ground
- Main beam direction

Furthermore, several Dutch mobile communication networks are accessible as well along the DE/NL-border.

Besides of telecommunication networks, there is large WDR[3] broadcasting station in Kleve that is responsible for broadcasting of several analogue and digital radio and television programs (VHF, DAB/DAB+, DVB-T[4]). The station is equipped with a steel tube pylon of 126 m height.

---

[2] Mobile antenna information: http://emf3.bundesnetzagentur.de/karte/default.aspx

[3] WDR: Westdeutscher Rundfunk (West German Broadcasting)

[4] VHF: Very High Frequency, DAB: Digital Audio Broadcast, DVB-T: Digital Video Broadcast Terrestrial)

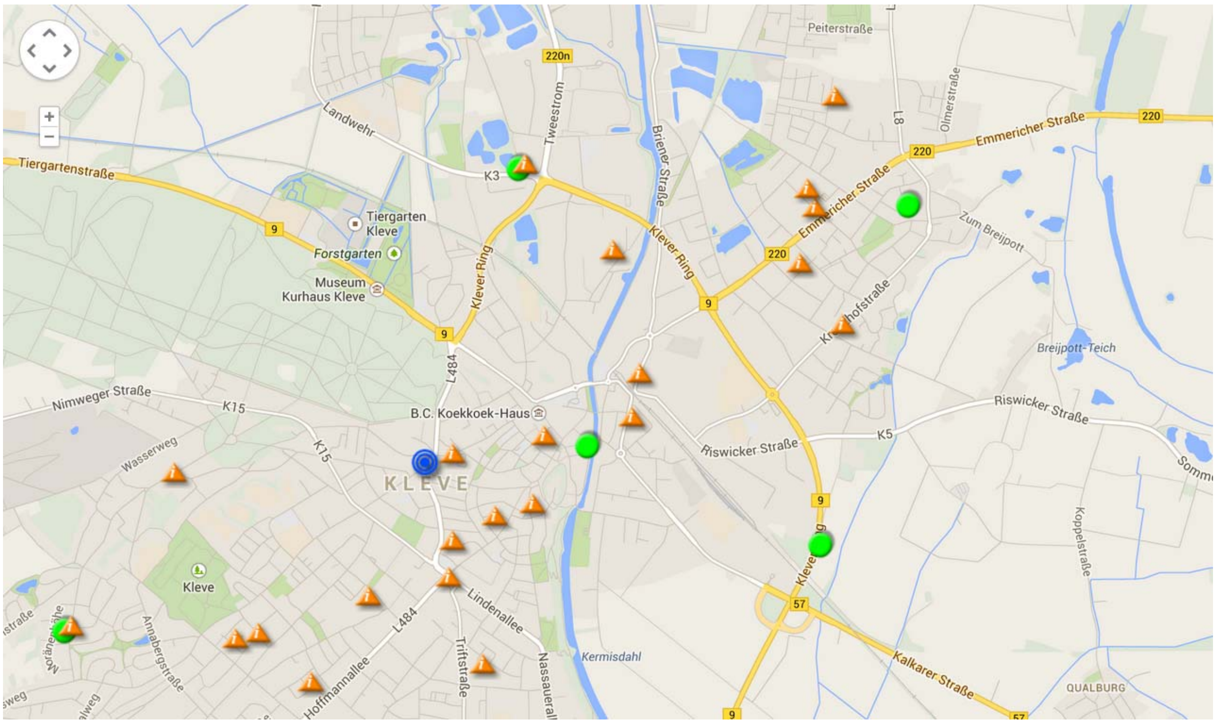


Figure 16: Positions of mobile network antennas (red triangles) in Kleve provided by German Federal Network Agency (Map source: Google Maps).

6.7.2 Dutch communication networks

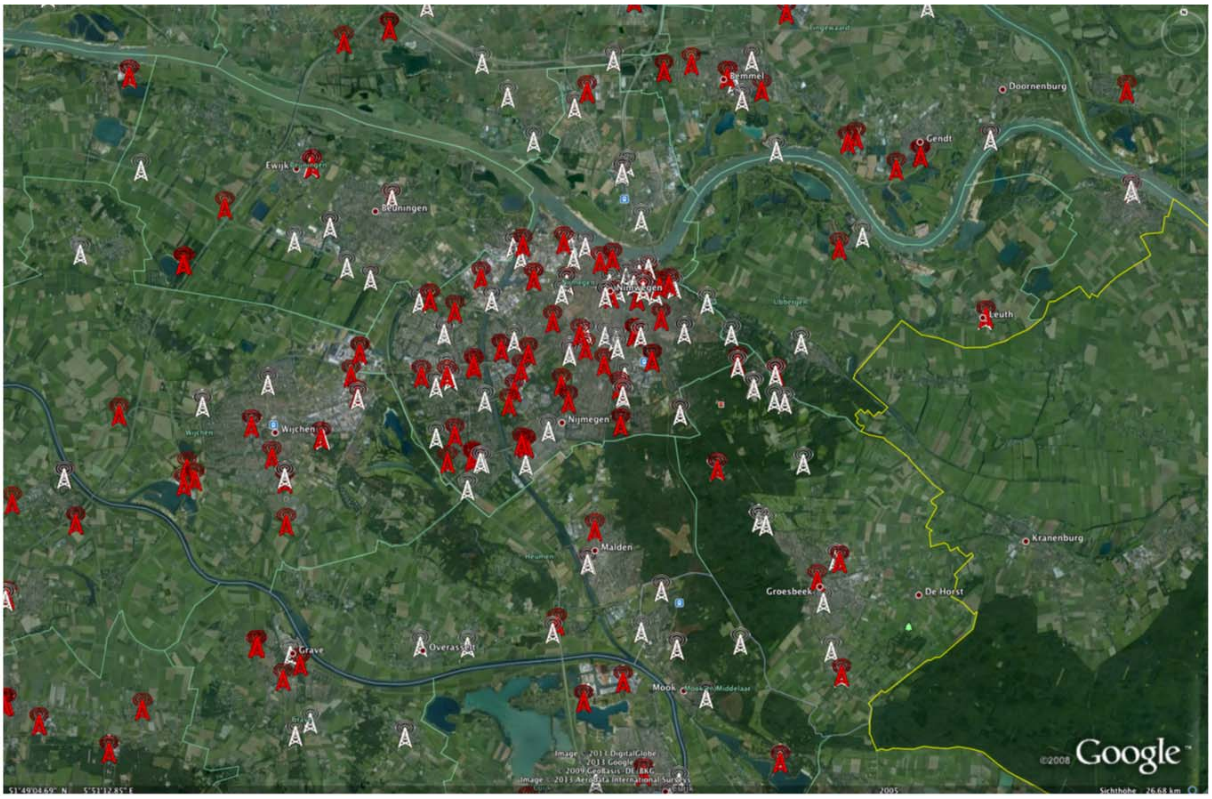


Figure 17: Positions of mobile network antennas (red triangles) around Nijmegen (Map: Source: Google Maps).

7 CI dependencies and interdependencies

A crucial modelling task will include the identification of the static dependencies between the CI of the cross-border scenario. Within this section we will briefly summarise some essential definitions and insights on CI dependencies.

As described previously, the European Commission defined different rules and guidelines to identify CI. These structures are ranked upon the scale of their impact in case of their disruption: local, national or European. European CI concerns only those infrastructures that could have a cross border effect on other countries.

Experts in each sector have built models and implemented them in simulators that could simulate the behaviour of a system and for instance the propagation of a failure inside their system. CIPRNet project will link many of them in order to build a "what-if" analysis tool. The "links" are dependencies and interdependencies. The definition of a dependency can be according to [Rinaldi1] "a linkage or connection between two infrastructures, through which the state of one infrastructure influences or is correlated to the state of the other". The definition of interdependency can be defined as "A bidirectional relationship between two infrastructures through which the state of each infrastructure influences or is correlated to the state of the other" [Rinaldi1]. It exists two commonly approaches for interdependencies [Huang1]: Empirical ones, focused on past events, and predictive ones, concentrated on modelling and simulating the behaviour of one system. It exist four kinds of dependency (or interdependencies if it is bidirectional):

- Physical: the material output of the first one is an input for a second infrastructure
- Cyber: The state of one infrastructure depends on the transmission of information from another infrastructure
- Geographic: A local event can create changes in each state of the closed spatial infrastructures
- Logical: Every link between two infrastructures that doesn't belong to the three up categories. Economics links or governmental decisions are logical interdependencies.

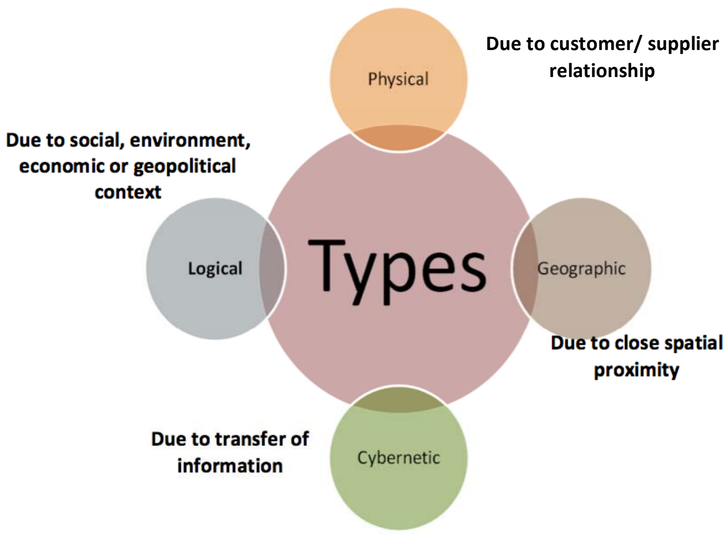


Figure 18: Dependencies typology [Rey1, Rinaldi1]

"It is commonly agreed that a universal, all-encompassing approach or model which accounts for all issues does not exist" [Kroger1]. The scope of the scenario described in Section 4.2 provides many boundary conditions but the modelling of the dependencies and interdependencies will not be complete. For instance the logical dependencies (see definition above) are very difficult to model. The geographic, physical and the cyber dependencies are at a high level easier to identify because of their direct technological links. Inside a same critical sector, experts integrated the dependency and interdependency model already by means of the different existing software.

In [Luiijf2], the dependencies from experiences in Europe between January 2005 and May 2009 were put together in a graphical way. The graph is reproduced in Figure 19. The thicker is the line the larger is the number of external or dependency events. “It will be obvious that in Europe the database shows that energy, telecommunications and Internet, and transport are the key critical infrastructures which disruptions are reported on in news reports” [Luiijf2]. From this dataset it was underlined that the major dependency type was physical.

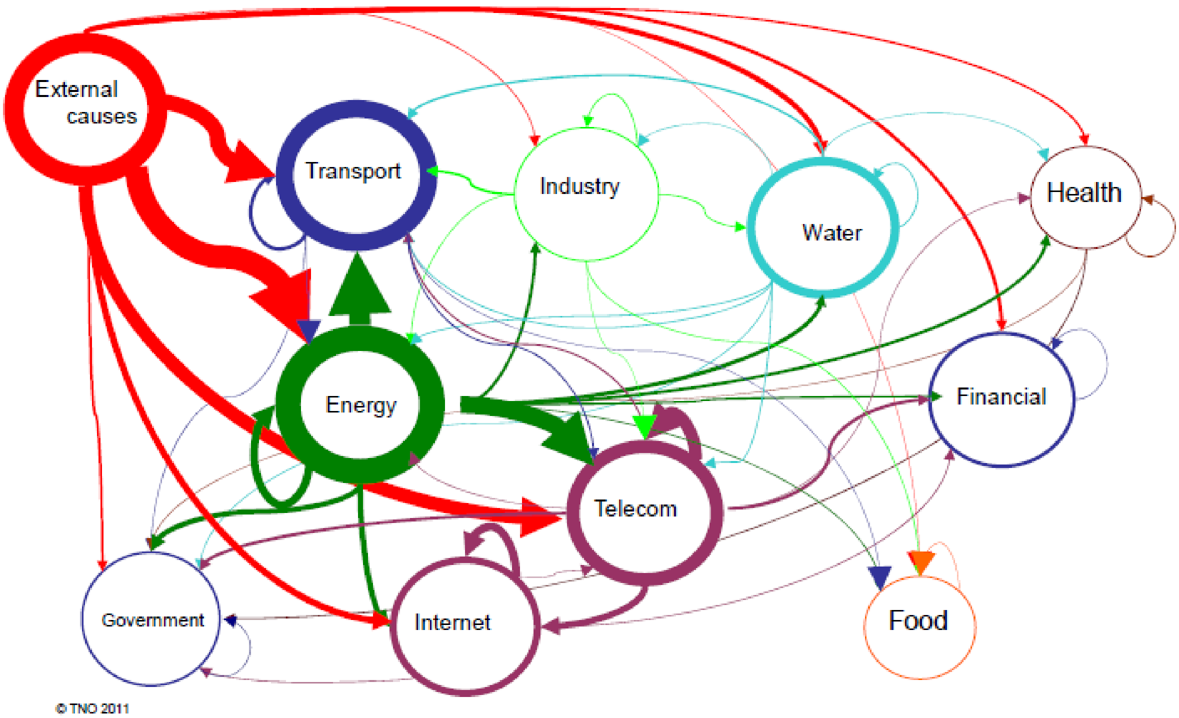


Figure 19: Dependencies between CI-sectors in Europe from empirical findings [Luiijf2]

An example on how CI dependencies can be modelled is provided in [DIESIS2], see Figure 20. Static models and static dependencies are modelled using service networks. The boxes in Figure 20 represent essential types of components of CI and of external threats. In the DIESIS example, electrical power transmission, fixed line telecommunication and a railway link with have been modelled. For each of these CI, the simple models contained between three and five types of CI elements, like signals or trains in the railway CI. The functioning of the CI was modelled via CI internal services (depicted by arrows that are annotated by the service names). Static dependencies between CI are also depicted via arrows, describing which CI offers which service(s) to another CI. As an external threat, a flooding due to heavy rainfall was modelled. This simple model increased the water level over time in a uniform way. Using water level thresholds, outages of CI elements occurred just when the water level at the position of the CI element exceeded a certain height.

For the simulation part, this network was first enriched by ICT (software) components for creating a distributed federated simulation (or co-simulation), consisting of one domain simulator per CI and per threat, and additional ICT components for control of the federation, logging and visualisation of simulation results, and communication between the distributed simulator and ICT components. During simulation, dynamic dependencies could occur. The communication middleware was designed to allow semantic interoperability (for example, ensuring the proper dimensions of parameters (like voltage)) and synchronisation for maintaining causality across the distributed federated simulation system.

In CIPRNet, this concept shall be further evolved in the following ways. First, the communication middleware shall experience improvements. Second, a sophisticated flood modelling system will replace the simple water level "simulation". Third, more CI will be added. Fourth, a complex event-processing engine called Esper will be employed for simulating external (with respect to the involved CI) events, allowing the modelling of more threats and also of mitigation actions. Fifth, some more suitable CI simulators will replace some of those used in DIESIS. Sixth, a new tool for static modelling will replace the service networks used in DIESIS. Seventh, we will add consequence analysis capabilities to the federated system (to be jointly developed with WP7 – DSS). Eighth, a new integrated GUI will enable a what-if analysis capability for end-users. For more details, please consult the forthcoming deliverable D6.1 [CIPRNetD61].

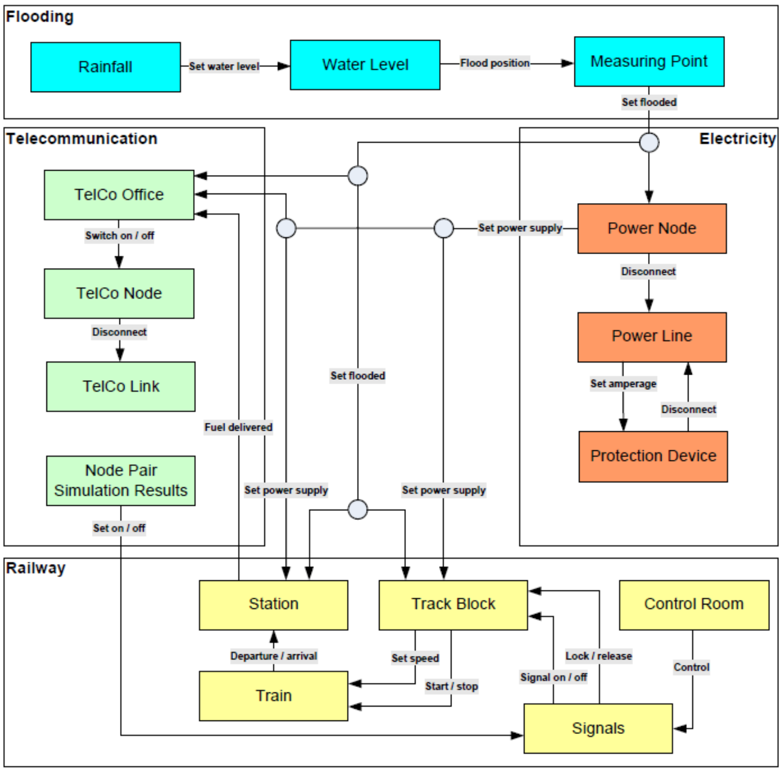


Figure 20: DIESIS Basic service network (source: Fraunhofer IAIS [DIESIS2])

8 Scenario storylines

8.1 Storyline 1: Cross border flooding with a major breach

8.1.1 Context

Phase description : Context			
Category	**Element**	**Description**	**Note**
Timeframe/ Duration	Point of time/ Event (s)	General situation 3 days before the large scale flood	In the middle of spring, a heat wave of one week increased the snow-melting rate in the Alps. Additionally, the lower Rheine region experienced four days of heavy rain. The water level river is thus high and the soil is saturated in the regions of Nijmegen and Kleve. Two days of rainfall interruption give time to the decision makers to analyse the hydrologic forecasts. A second heavy rain wave is predicted for the following week and the Rheine level could reach the critical level for which the protection dikes have been built. The responsible of the maintenance of the dikes has also previously reported few weak points in the north dike on the German side.
Incident description	Current status of the incident	No incident yet	
Critical Infrastructure(s) that could be concerned during the next phases	Name/ Sector (NC: Nijmegen City, EaR: Emmerich am Rhein, KC: Kleve City, KR: Kleve Region, NR: Nijmegen Region)		
	NC1a: A major transformer along the Rhein		Could be directly flooded
	NC5a: Ziekenhuis Canisius Wilhemina (653 Beds), close to one Rheine channel		Could be directly flooded
	EaR IXa: ICE train, major European axes, between Frankfurt and Amsterdam up to 8 return journeys per day. Low altitude station.		Could be directly flooded
	EaR X: A chemical industry between the Rhein and Emmerich am Rhein		Could be directly flooded
	NR 1a : Major electrical node with transformers		Could be directly flooded

NR 9 : Motorways A12 and A18	Could be directly flooded
Others CI (See GIS database)	

8.1.2 Timeline

8.1.3 Phase 1: Dike breach around Rees city (Germany)

Phase description : dike breach around Rees city (Germany) [1]			
Category	**Element**	**Description**	**Note**
Timeframe / Duration	Point of time/ Event (s)	Day 1 (a Monday) @ 10 am. A breach in the north dike, near Rees city.	The heavy rain lasted for two days. The critical Rhine water level has been reached and a weak point of the dike collapsed.
Incident description	Current status of the incident	The water runs through the breach instantaneously towards Emmerich am Rhein.	The technical responsible had to stop the guard's tour on the dike for security reasons. The state of the dike is now only monitored by the local sensors. Suddenly, the civil protection services report a large number of emergency calls from Rees city: the dike has a large breach and the water level rises rapidly. Most of the isolated houses in the flood plains are already isolated due to the water.
***Critical Infrastructure(s)* (only the affected/changed)**	Name/Sector	Chemistry: The chemical industries of Emmerich am Rhein.	These CI are reached by the water at 11.30.
	Location	51°49'53.48"N 6°13'51.98"E	
	Status	Some chemicals stocks are flooded. Although they are waterproof, the Rheine level is rising up. A shock with floating debris could damage the barrier and create a huge pollution.	
	Level or Mode of operation	All operations in the factory are interrupted and only the surveillance and the emergency teams are maintained on the sites.	Evacuation of the non-needed personal has to be organized by the emergency services. Strengthening barriers have been requested by the two factory persons in charge.

Map(s)

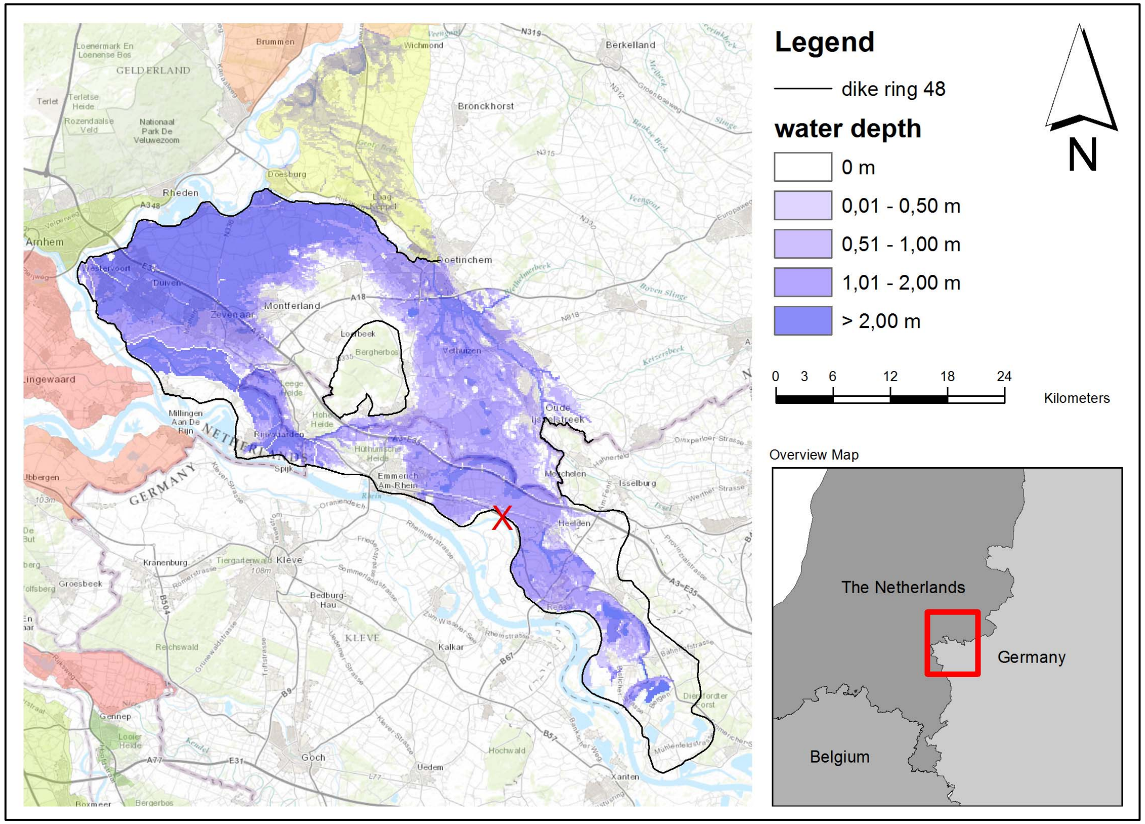


Figure 21: First phase map representing a dike breach (red cross) around Rees city (Germany) (source: [Burzel1], based on flood scenarios provided by the Dutch water boards).

8.1.4 Phase 2: A transformer in Emmerich am Rhein is flooded

Phase description : A transformer in Emmerich am Rhein is flooded [2]			
Category	**Element**	**Description**	**Note**
Timeframe/ Duration	Point of time/ Event (s)	Day 1 4 pm (to be updated by flood simulation) Flooding of a main transformer.	It is a permanent and immediate failure during the flood.
Incident description	Current status of the incident	This electric transformer provided electricity to the all cities of EaR. Two main CI are affected: The hospital and the train station.	
***Critical Infrastructure(s)* (only the affected/changed)**	Name/ Sector	1) Health: Sankt Willibrord-Spital Emmerich-Rees 2) Transport: Trains and local roads	1) The hospital cannot be flooded (15m high), but it is surrounded by the water. 2) One ICE train from Frankfurt and with destination Amsterdam is blocked in EaR station.
	Location	1) 51°49'58.51"N 6°14'19.60"E 2) 51°50'2.17"N 6°15'39.60"E	
	Status	1) The hospital is functioning on backup generator and needs regular fuel supply.	1) The evacuation of the patients by boat+road and by helicopters has to be organised. Decision makers have to be plan how to dispatch the numerous victims to other hospitals (possibly to the Netherlands too). 2) The two hundred travellers blocked at the train station must receive water and food and their evacuation to their final destination (Amsterdam or Utrecht) has to be organised.
	Level or Mode of operation	1) The hospital stopped all surgeries and can't receive any new patient. Small care can still be executed by the personal. 2) All transportation is stopped but the com-	

	munication to the travellers is insured by the personal of the train station.
Map(s)	

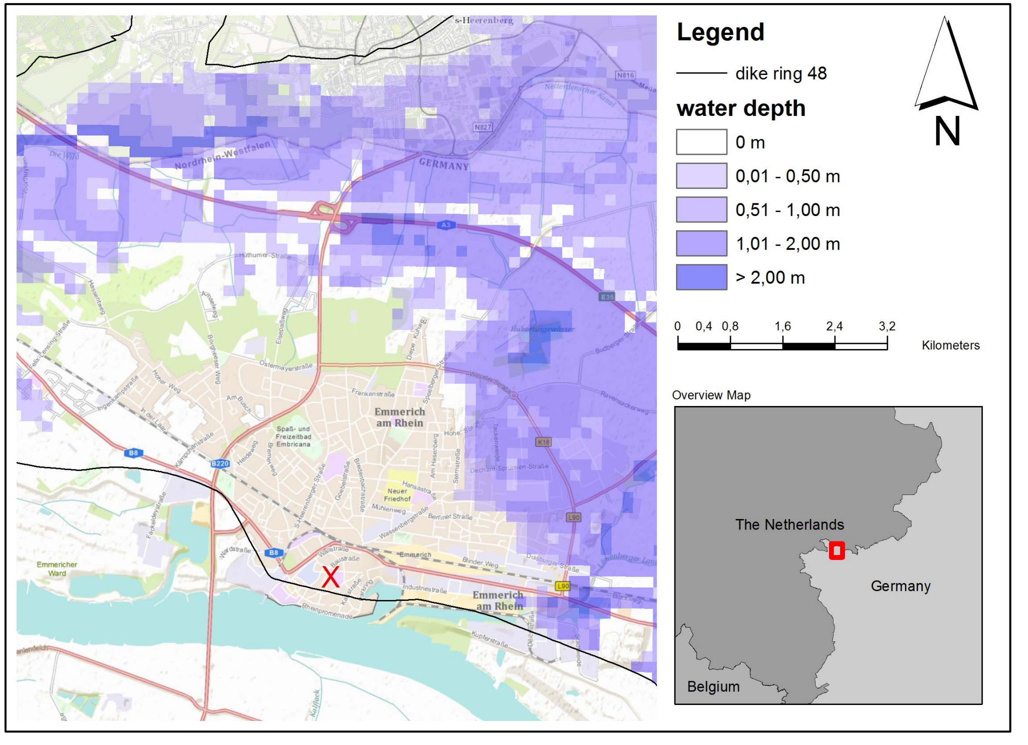


Figure 22: Map of the flooding in Emmerich am Rhein. The hospital (red cross) and the train station are surrounded by water (source: [Burzel1], based on flood scenarios provided by the Dutch water boards).

8.1.5 Phase 3: The flood propagate into the Netherlands

Phase description : The flood propagate into the Netherlands [3]			
Category	**Element**	**Description**	**Note**
Timeframe/ Duration	Point of time/ Event (s)	Day 3 @ 3am The flood expends and crosses the Dutch border near Spijk city (NL).	
Incident description	Current status of the incident	The water runs towards the North.	The little cities in the north of Nijmegen are flooded one by one. The citizens are informed slowly as it is the middle of the night.
***Critical Infrastructure(s)* (only the affected/changed)**	Name/ Sector	Transport: - Motorways + local roads - Spoortunnel Pannerdensch Kanaal	The northern motorways (A12 and A18) are blocked. The Spoortunnel Pannerdensch Kanaal for the freight trains between Rotterdam to Germany is also blocked, its gates of flood protection have been activated.
	Location	Betuwe tunnel : 51°54'45.06''N 5°59'18.27''E Motorways (see map next page)	
	Status	The Spoortunnel Pannerdensch Kanaal is in security state with a constant monitoring of the water gates. Motorways (A12 and A18) are flooded on the zone shown in the map.	Few car drivers have been trapped on the motorways and are being evacuated.
	Level or Mode of operation	Interruption of the train freight corridor between Rotterdam and Germany. Motorways (A12 and A18): no car allowed to drive on.	

Map(s)	Decision makers have to block the roads around the flooding zone, to communicate on it. They have to anticipate to the coming flood around the electric station.

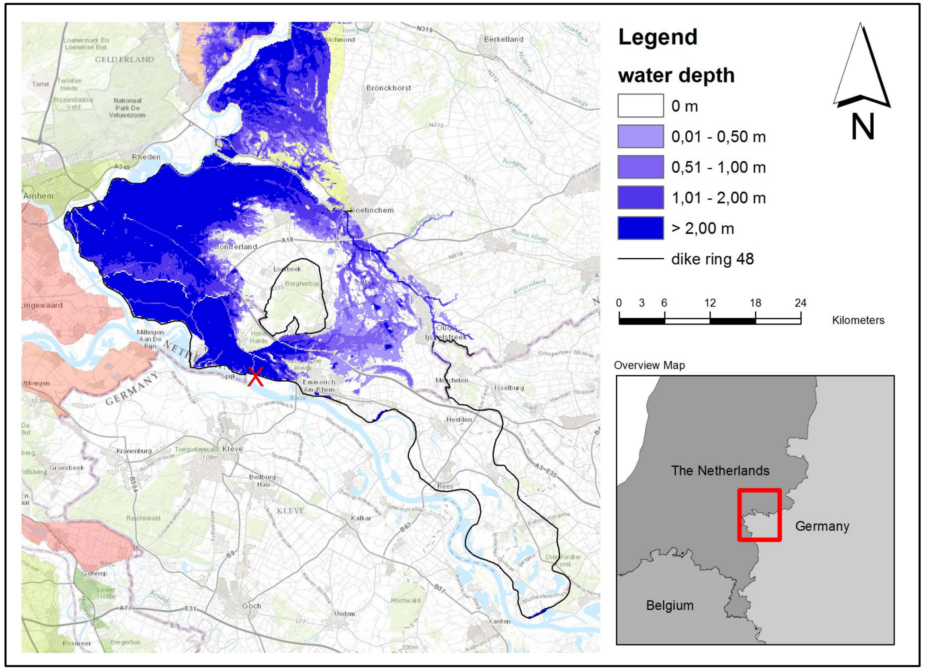


Figure 23: Map of the results of the second dike breach near upstream of Emmerich (Spijk, at the border of the Netherlands). The northern motorways and the access of the Spoortunnel Pannerdensch Kanaal in the Betuwe freight railway line connecting Rotterdam to Germany are flooded (source: [Burzel1], based on flood scenarios provided by the Dutch water boards).

8.1.6 Phase 4: large electricity station of 380 kV interrupted.

Phase description : The flooding reaches Langerak (NL) and the large electricity station of 380 kV is interrupted. [4]			
Category	**Element**	**Description**	**Note**
Timeframe/ Duration	Point of time/ Event (s)	Day 3 @ 7am Large electricity station at Doetinchem flooded	This 380 kV station provides electricity to a large region in the Netherlands. The simulation will define the real impact of this lost.
Incident description	Current status of the incident	Flooded	This step depends on the reactivity of the decision makers to protect with a waterproof barrier this station.
Critical Infrastructure(s) **(only the affected/changed)**	Name/ Sector	Electricity: Doetinchem electricity station	The Netherlands rescue teams are stressed by the number of people blocked in their houses. The little roads are blocked.
	Location	51°55'40.90"N 5°40'3.74"E	
	Status	Disrupted	
	Level or Mode of operation	- -	The responsible should have stopped the electricity station before the flood for security reason.
Map(s)			All the hospital patients will have to be dispatched to safe hospitals in the Netherlands and possibly in Germany. This is in parallel with all the rescue actions in the wide flooded zone. The decision makers will have to call the European rescue centre.

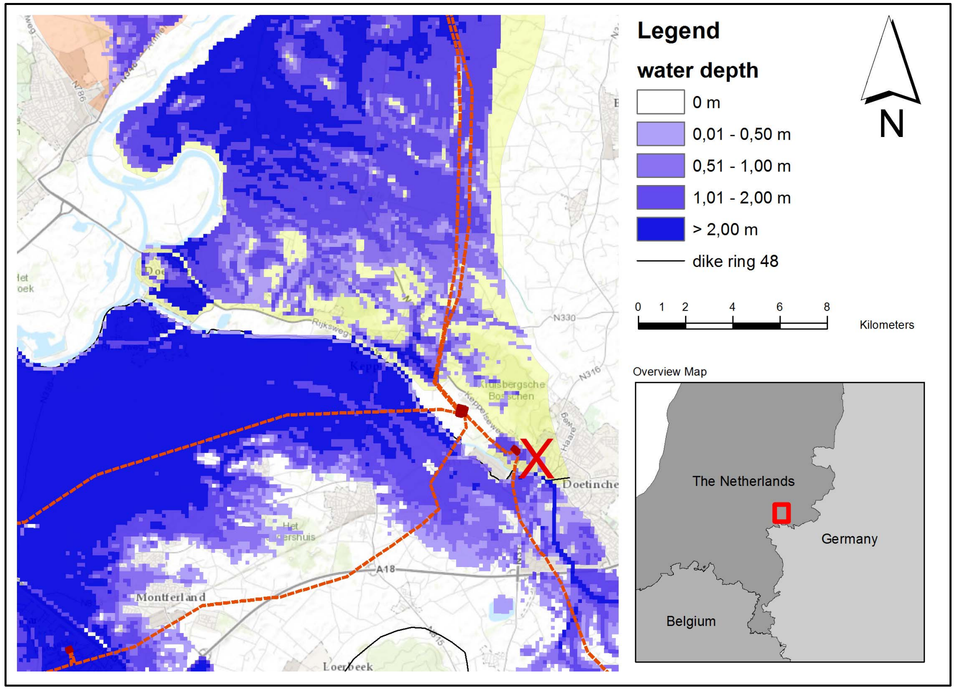


Figure 24: Map of the flooding which reached a power station in Doetinchem (NL) (source: [Burzel1], based on flood scenarios provided by the Dutch water boards).

8.2 Storyline 2: Railway accident in Emmerich am Rhein

8.2.1 Overview

The German city "Emmerich am Rhein" (see the red circle in Figure 25) locates near the border of Germany and the Netherlands. It is a small city with a population of about 30,000. The river Rhine flows through Emmerich and the city has an average elevation of 15 meter. Different infra-structure facilities like railway, harbour, glider airport, power generators and transmission networks, etc. can be found near Emmerich.

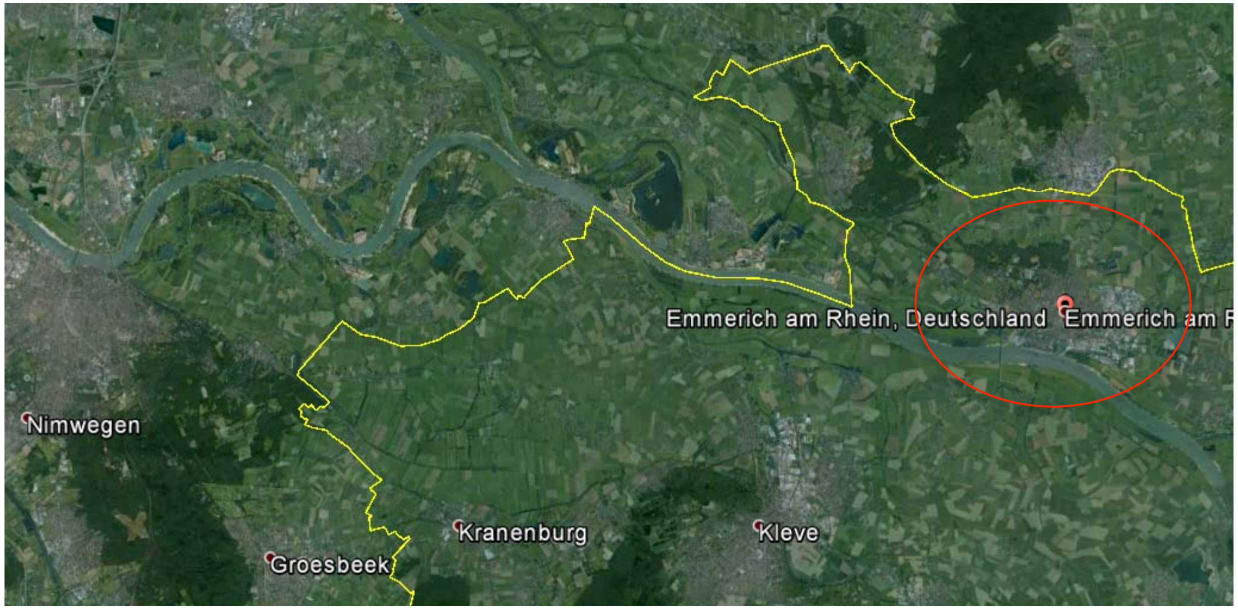


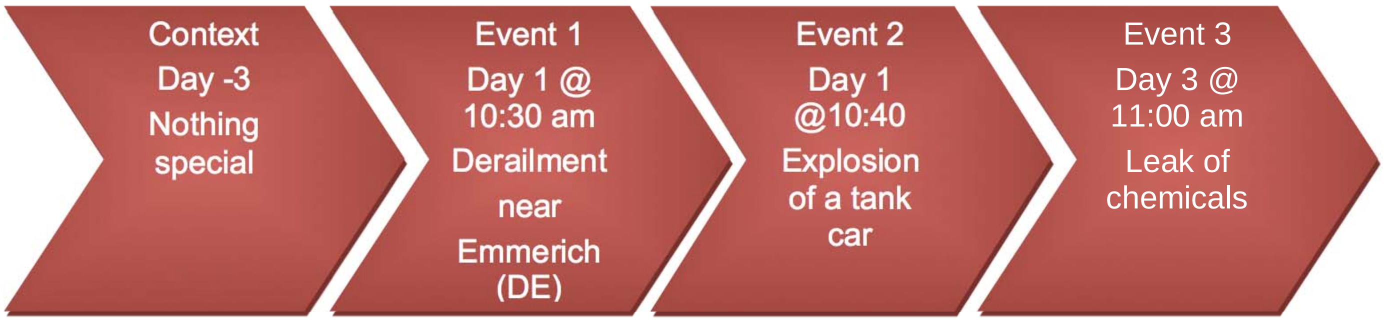
Figure 25: Location of the German city Emmerich, The border between Germany and the Netherlands is illustrated as yellow lines (source: Google Maps).

This storyline supposes a train derailment on DAY0 near the main station of Emmerich. The location of the derailment is at (Latitude: 51.83528, Longitude: 6.246653) which is illustrated in Figure 26. The incident happens near the centre of the city and supposes to cause serious damages and consequences if no appropriate crisis management has been performed.

8.2.2 Context

Phase description : Context			
Category	**Element**	**Description**	**Note**
Timeframe/ Duration	Point of time/ Event (s)	General situation 3 days before the railway accident	Nothing special
Incident description	Current status of the incident	No incident yet	
Critical Infrastructure(s) that could be concerned during the next phases	Name/ Sector	NC: Nijmegen City, EaR: Emmerich am Rhein, KC: Kleve City, KR: Kleve Region, NR: Nijmegen Region	
		EaR IXa: ICE train, major European axes, between Frankfurt and Amsterdam up to 8 return journeys per day.	Directly affected
		Highway A3/E35, Bundesstrasse 8 – road transport sector	Directly affected
		Gas pipeline – energy sector	Not affected in storylines
	Other CI	See GIS database	

8.2.3 Timeline



8.2.4 Phase 1: Cargo train derailment near Emmerich main station (Germany)

Phase description : Cargo train derailment near Emmerich main station (Germany)			
Category	**Element**	**Description**	**Note**
Timeframe/ Duration	Point of time/ Event (s)	Day 1 (a Monday) @ 10:30 a.m.	
Incident description	Current status of the incident	A cargo train coming from the Netherlands derails in the city of Emmerich.	The accident is due to a defective switch shortly before the street "Am Löwentor". The train has loaded chemicals and liquid gas. The coupling of the first derailed car breaks, the leading part of the train with 12 cars rolls on through Emmerich station, with the last of the 12 cars derailed, too. The trailing part of the train crashes into some houses at "Am Löwentor" and Bundesstrasse 8.
Critical Infrastructure(s) **(only the affected/changed)**	Name/Sector	Power Grid and transport: The distribution networks and the railway and the motorway traffics near Emmerich am Rhein.	
	Location	51°49'53.48"N 6°13'51.98"E	
	Status	A tank car loaded with liquid gas explodes and sets fire to several houses and other cars of the train. Wind comes from varying, mainly south-western, directions. The wind blows smoke of the liquid gas and some chemicals into the north-eastern direction, across larger parts of Emmerich including the highway A3, and the Dutch town 's-Heerenberg which is just 2 km north of Emmerich.	
	Level or Mode of operation	• Deutsche Bahn and Nederlandse Spoorwegen have to be informed. Emergency planning has to be performed.	

		• A3 has to be closed and Dutch authorities need to be alarmed. • B8 has to be blocked in the east at crossing Weseler Straße. • Detours for drivers on B8 have to be signalled. → Drivers from east start the detour in the city of Rees, taking B67 across Rees Rhine bridge, Kalkar, B57, B9, B220, Emmerich Rhine bridge, B8. Drivers from west start the same detour in the opposite direction in Emmerich (see Figure 27). • Emergency management of Kreis Kleve is informed and starts coordinating mitigation actions. • Population is informed to stay home and keep windows closed. • Citizens in the vicinity of the crash site are evacuated.
Map(s)	See next page	

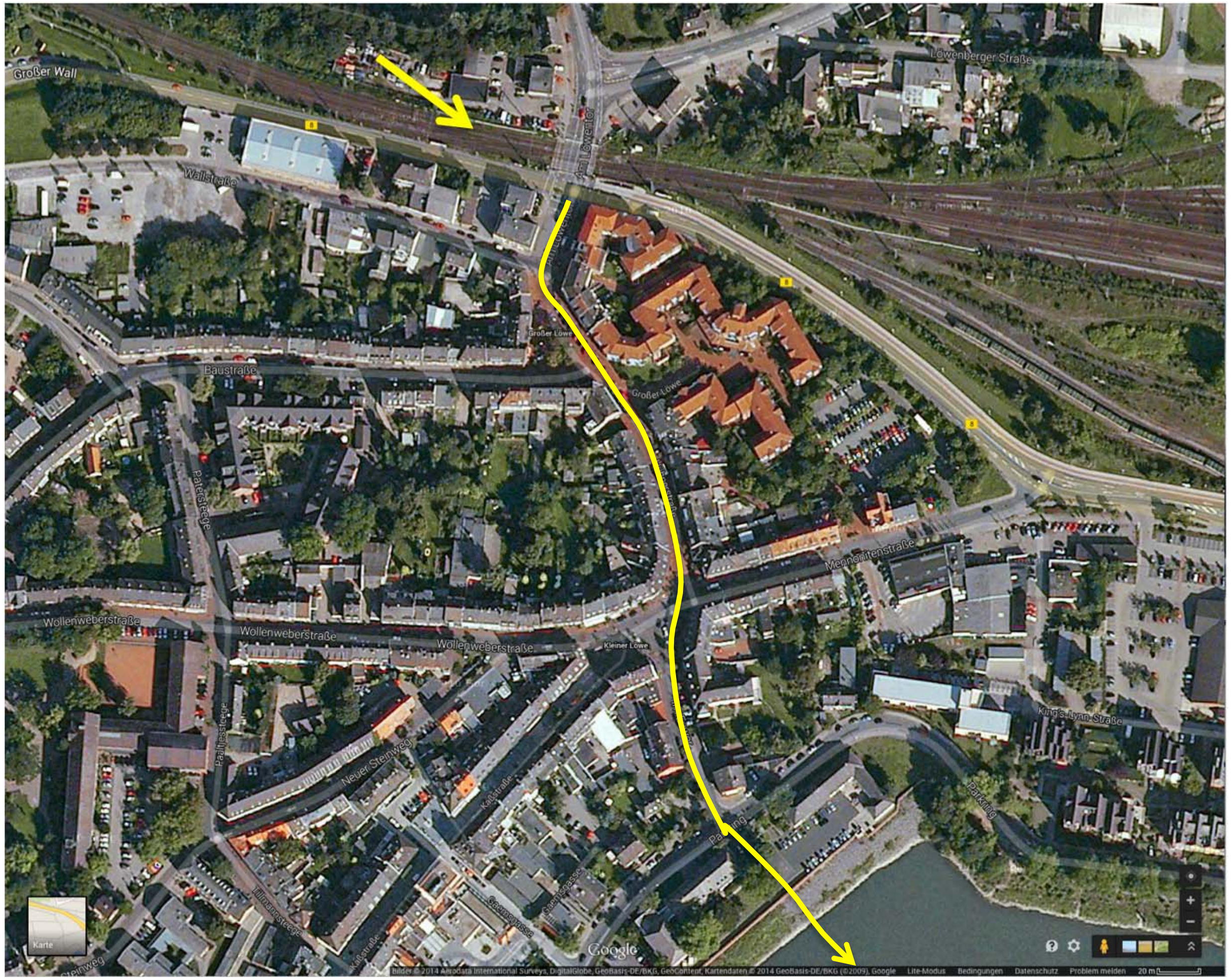


Figure 26: The location of the train derailment (source: Google Maps)

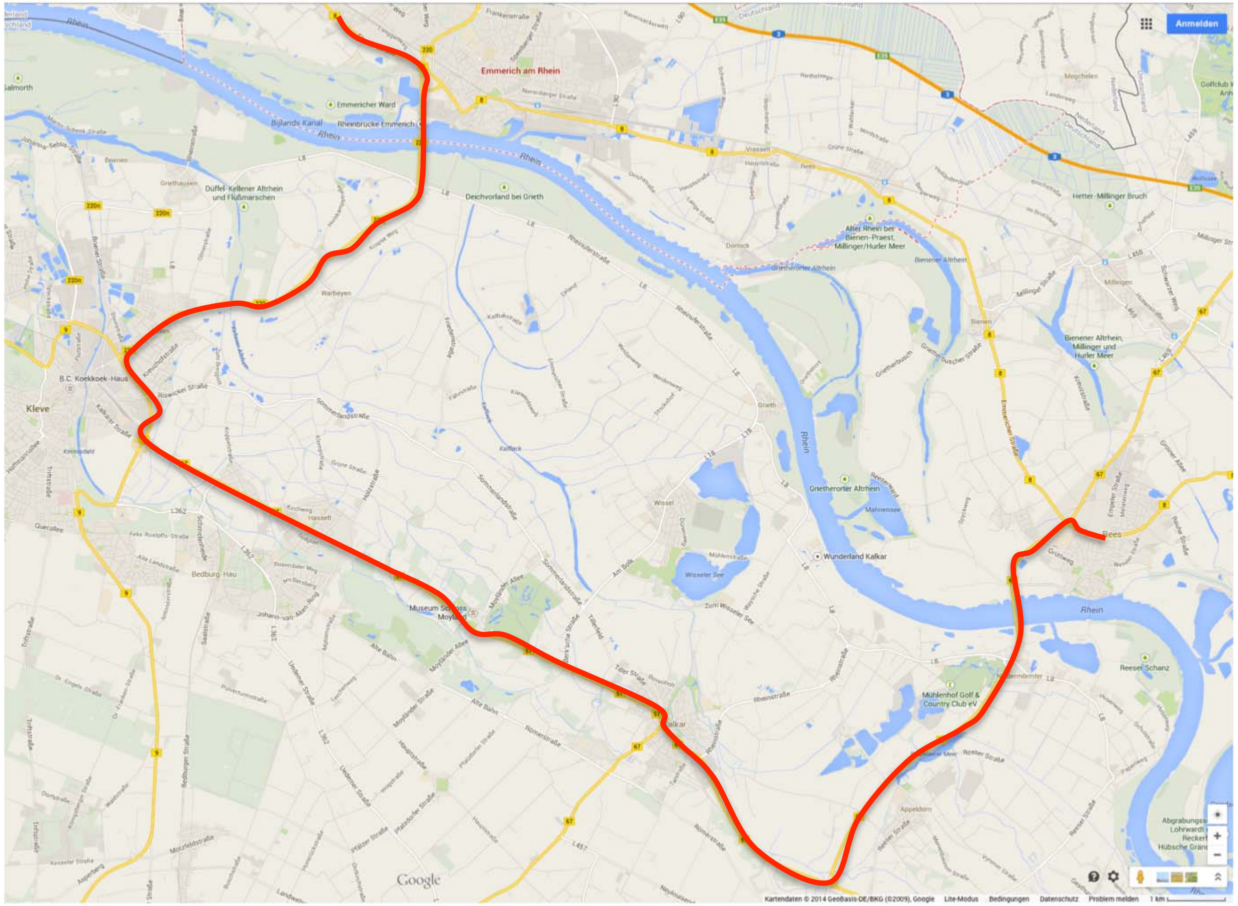


Figure 27: Detour plan for the drivers from western and eastern parts of Emmerich (source: Google Maps)

8.2.5 Phase 2: Explosion of a tank car

Phase description : A transformer in Emmerich am Rhein is flooded [2]			
Category	**Element**	**Description**	**Note**
Timeframe/ Duration	Point of time/ Event (s)	Day 1 10:40 am	
Incident description	Current status of the incident	A tank car loaded with liquid gas explodes and sets fire to several houses and other cars of the train. Wind comes from varying, mainly south-western, directions. The wind blows smoke of the liquid gas and some chemicals into the north-eastern direction, across larger parts of Emmerich including the highway A3, and the Dutch town ’s-Heerenberg which is just 2 km north of Emmerich.	
Critical Infrastructure(s) **(only the affected/changed)**	Name/Sector	Transport	
	Location	highway A3	
	Status	blocked	
	Level or Mode of operation	• Hospitals in Emmerich, Rees, Kleve, Anholt and other locations are informed. • All forces of the (mostly voluntary) fire-fighters in the vicinity (see Figure 4) are alarmed, including the Emmerich fire-fighters from Hüthum and Pastor-Breuer-Straße, those of the villages Klein-Netterden and Borghees on the right side of the Rhine, and those of Kleve, Kalkar and the villages Kellen and Huisberden (Bedburg-Hau) on the left side of the Rhine (need to take the street bridge Rhein bridge Emmerich and access the disaster location via B8). • Forces from Pastor-Breuer-Straße cannot approach the disaster location via Pastor-Breuer-Straße and Speelbergerstraße from northern direction due to the heavy smoke. They have to take a different way via Weseler Straße and B8 from eastern direction. Forces from Hüthum approach via B8 from western direction.	

Map(s)	See Figure 25, Figure 26 and Figure 27

8.2.6 Phase 3: Leak of chemicals

Phase description : Leak of chemicals, [3]			
Category	**Element**	**Description**	**Note**
Timeframe/ Duration	Point of time/ Event (s)	Day 1 @ 11:00 am	
Incident description	Current status of the incident	Some cars loaded with chemicals get heavily damaged. Chemicals spill out of the cars, some of them ignite. The derailed cars and the fire destroy parts of the railway tracks' infrastructure, including overhead wires (causing traction current short circuits) and masts, signal cables, tracks, and track beds.	
Critical Infrastructure(s) **(only the affected/changed)**	Name/ Sector	Water distribution Over river transport	
	Location	See GIS map	
	Status		
	Level or Mode of operation	• Waterworks are alarmed, and emergency plans for purification plants are activated. • The glider airport is informed, starts are prohibited, aired gliders are required to land. • The industrial harbour is informed	
Map(s)	See Figure 25, Figure 26 and Figure 27		

9 Conclusion

This document contains a detailed description of the cross-border application scenario for the forthcoming new CIPRNet capability of what-if analysis. For the cross-border application scenario, the authors have chosen a densely populated area in the Dutch-German border region between the city of Nijmegen on the Dutch side and the district of Kleve on the German side. The chosen area contains several smaller and larger cities. The river Rhine, one of the major waterways in Europe that connects North Sea harbours to several central European countries, runs through the area. CI in the area includes, besides the usual supply CI, some special cross-border infrastructures that are worth mentioning explicitly. The first one is the Dutch Betuwe route, a railway track on which cargo trains run from Rotterdam harbour to Zevenaar, and via its connections on the German side further to the European hinterland (Rhine-Alps corridor). The second one is the highway A3/E35, and the third is a gas pipeline.

Regarding possible threats, the authors have elaborated two storylines for two different threats. The first incident involves a flood of the Rhine due to dike breaches. The second incident is a cargo train derailment in the city centre of Emmerich.

In order to prepare the modelling of the scenarios for the new CIPRNet capabilities of what-if analysis and Decision Support System, the authors have started collecting data on the region in a local Geodatabase (GeoDB), and processing and integrating them by means of a common desktop GIS application (Quantum GIS). For the final dataset, the consortium will use geo-Platform (an application developed by geoSDI team [GeoSDI]), which is a system that is compliant with a similar platform already in use by Italian civil protection. For the German part of the scenario, Fraunhofer owns socio-demographic data (also integrated into Quantum GIS) that are aggregated at street segment and ZIP code levels. These data include the number of residents, households and businesses per level (street or ZIP code area), the coarse age structure of residents, the average GDP per level, and more. These socio-demographic data will later be employed for consequence analysis.

The authors have elaborated the scenario descriptions in a uniform way, taking into account best practices of scenario descriptions found elsewhere and insights from evaluations of lessons learned from flood-related exercises in EU civil protection exercises (see Annex I of this document).

Also, Deltares will provide possible flood scenarios by means of a flood scenario database in the region under consideration that will be integrated in the federated simulation system to be developed in WP6. The next steps towards realisation of the scenario will include the collection of further data on CI and their dependencies in the cross-border area and their transformation into simulation models along

10 References

[Bayern1] Das Junihochwasser 2013 in Bayern - Wasserwirtschaftlicher Bericht, http://www.bestellen.bayern.de/application/applstarter?APPL=STMUG&DIR=stmug&ACTIONxSETVAL%28artdtl.htm,APGxNODENR:84,AARTxNR:lfu_was_00087,USERxBODYURL:artdtl.htm,KATALOG:StMUG,AKATxNAME:StMUG,ALLE:x%29=X

[Beerens1] R.J.J. Beerens, B. Kolen, I. Helsloot, EU FloodEx 2009: An analysis of testing international assistance during a worst credible flood scenario in the North Sea area, in Flood Recovery, Innovation and Response II, WIT press, 2010, pp. 241-255.

[BMLFUW1] BMFLUW: Offizieller Hochwasserbericht BMLFUW Österreich http://www.lebensministerium.at/wasser/wasser-oesterreich/wasserkreislauf/hochwasser2013-1.html

[Bouchon1] S. Bouchon, “The Vulnerability of interdependent Critical Infrastructures Systems: Epistemological and Conceptual State-of-the-Art.” In: for Official Publications of the European Communities EUR 22205 EN, O. (Hrsg.): European Commission, Directorate-General Joint Research Centre, Institute for the Protection and Security of the Citizen, (2006)

[Burzel1] A. Burzel, Micheline W.A. Hounjet, B. P.J. Becker, A. di Pietro, M. Pollino, V. Rosato, A. Tofani: Towards a decision support system for consequence analysis of flooding on critical infrastructure. Proceedings 11th International Conference on Hydroinformatics 2014, New York.

[CDP787] EC, “Proposal for a DIRECTIVE OF THE COUNCIL on the identification and designation of European critical infrastructures and the assessment of the need to improve their protection”, COM(2006)787, 2006/0276 (CNS), Brussels, Belgium, (12 December 2006)

[CD114] EC, “Council Directive on the identification and designation of European critical infrastructures and the assessment of the need to improve their protection”, 114/EC, Brussels, Belgium, (8 December 2008)

[CEDIM1] CEDIM Forensic Disaster Analysis Group (FDA) Bericht 2: Juni Hochwasser 2013 in Mitteleuropa - Fokus Deutschland, http://www.cedim.de/download/FDA_Juni_Hochwasser_Bericht2.pdf

[CIPRNetD61] EU FP7 CIPRNet, Fraunhofer, Deliverable D6.1 Conceptual design of a federated and distributed cross-sector and threat simulator (forthcoming)

[DIESIS1] EU FP7 Project DIESIS, Fraunhofer, Deliverable D4.1b “Final Architectural Design” (2010), http://www.diesis-project.eu/include/Documents/DIESIS_Final_Architectural_Design.pdf

[DIESIS2] EU FP7 Project DIESIS Fraunhofer, Deliverable D4.2a “Proof of concept” (2010)

[DoW] Annex I – Description of Work (Annex to the Grant Agreement of CIPRNet, 2013)

[ECC1] From the 2013 call for proposals of Civil Protection Mechanism Exercises: http://ec.europa.eu/echo/funding/opportunities/calls/2013_call_CP_Mechanism_Exercises_en.htm

[EEA1] Environment issue report No24 “Scenarios as tools for international environmental assessments” ISBN 92-9167-402-8 (2001)

[ENISA1] http://www.enisa.europa.eu/activities/Resilience-and-CIIP/cyber-crisis-cooperation/cce/cyber-europe/cyber-europe-2012/

[FPBE1] FP7 FloodProBE Deliverable 2.1 “Identification and analysis of most vulnerable infrastructure in respect to floods” (2013)

[geoSDI] geoSDI team, http://www.geosdi.org/index.php/en/

[Heijden1] Kees van der Heijden, "Scenarios The Art of Strategic Conversation", Wiley New York (1996)

[Heijmans1] R.W.M.G. Heijmans and J.A.G. Jansen, "Design Features of the Pannerdensch Kanaal Tunnel in the Betuweroute" Tunnelling And Underground Space Technology, Vol. 14, Nb 2, pp. 151–160 (1999)

[Huang1] C.-N. Huang, J. Liou, Y.-C. Chuang, "A Method for Exploring the Interdependencies and Importance of Critical Infrastructures. In: Knowledge-Based Systems" Vol. 55, S. 66–74, (2014)

[ICCIP1] W.J. Tolone, S.-W. Lee, W.-N. Xiang, R.K. McNally, A. Schumpert, "Effective scenario composition for the revelation of blind spots in critical infrastructure protection planning" 1st Annual IFIP Working group 11.10 International Conference in Critical Infrastructure Protection, (2007)

[Kirchbach1] Kirchbach et al. (2002): Bericht der Unabhängigen Kommission der Sächsischen Staatsre- gierung – Flutkatastrophe 2002 (Report of the Independent Commission of the Saxonian State Government – Flood Catastrophe 2002)

[Kroger1] KROGER, W. & ZIO, E.: Vulnerable Systems. In: London (Hrsg.): Springer, (2011)

[Luiijf1] H.A.M. Luiijf, D.J. Stolk, "An international tabletop exercise on critical infrastructure protection: the lessons identified", Int. J. Critical Infrastructures, Vol. 6, No. 3, pp. 293–303, (2010)

[Luiijf2] H.A.M. Luiijf, A.H. Nieuwenhuijs and M.H.A. Klaver "Empirical findings on European critical infrastructure dependencies" Int. J. System of Systems Engineering, Vol. 2, No. 1, pp. 3–18, (2010)

[Miller1] K.D. Miller, H.G. Waller, "Scenarios, Real Options and Integrated Risk Management" Long Range Planning 36, pp. 93–107, (2003)

[QGIS] Quantum GIS, http://www.qgis.org

[Rey1] B. Rey, "Interdependencies Between Industrial Infrastructures : Territorial Vulnerability Assessment" In: 14th International Symposium on Loss Prevention and Safety Promotion in the Process Industries. Session : Risk Management and Regulatory Issues., (2013)

[Rinaldi1] S.M. Rinaldi, J.P. Peerenboom, Terrence K. Kelly, "Identifying, Understanding, and Analyzing Critical Infrastructures Interdependencies", IEEE Control Systems Magazine, pp. 11–25, (2001)

[Rome1] E. Rome, P. Langeslag, A. Usov, "Federated modelling and simulation for critical infrastructure protection" In proceeding of: Networks of Networks: The Last Frontier of Complexity, (2014)

[Sachsen1] Landesamt Sachsen: Gewässerkundlicher Monatsbericht mit vorläufiger Auswertung des Hochwassers Juni 2013, http://www.umwelt.sachsen.de/umwelt/wasser/download/Kurzbericht_Juni_2013_130820.pdf

[Smith1] R. Smith, "The long history of gaming in military training" Simulation Gaming, vol. 41, no. 1, pp. 6–19, (2010)

ANNEX I: LESSONS LEARNED FROM FLOOD-RELATED EXERCISES IN EU CIVIL PROTECTION EXERCISES

Author: M. Theocharidou, JRC. Contributor: C. Pursiainen, JRC

1 Introduction

The report gathers the experiences of international civil protection exercises (mainly within EU) and contributes its findings to the design of a cross-border scenario. The main sources were publically available reports describing the planning or evaluation of exercises. In the following section, the European Mechanism for Civil Protection is described. The majority of identified exercises simulate conditions that require the activation of the European Civil Protection Mechanism, the involvement of Participating States through the Emergency Response Coordination Centre (ERCC (former Management Information Center)), mainly with deployment of intervention teams (including modules), teams of experts, national key contact point staff, officials of the Institutions and other intervention support. It should be pointed that these exercises focus mainly on civil protection as opposed to critical infrastructure protection. Therefore the findings presented in Section 3 are largely based on this specific type of exercises; nonetheless, there was an effort to identify the infrastructures affected or the infrastructures that need to be available for mitigating the threat scenario. In Section 4, additional findings by various international exercises, with other threat scenarios, such as earthquake, cyber-attack, pandemic, etc. CIPRNet has a clear focus on CIP and this should be reflected on the selected scenario, but it is also important the scenario takes into account the expectations and priorities set by the end users.

2 The European Mechanism for Civil Protection

The European Mechanism for Civil Protection[5] aims to improve existing procedures related to the assistance needed by affected countries in case of major disasters with cross-border effects and to accelerate response in major emergencies. The Community Mechanism for Civil Protection has a number of tools intended to facilitate both adequate preparedness as well as effective response to disasters at a community level:

- The Emergency Response Coordination Centre (ERCC) is the operational heart of the Mechanism. It is operated by DG ECHO of the European Commission and accessible 24 hours a day. It gives countries access to a platform, to a one-stop-shop of civil protection means available amongst the all the participating states. Any country inside or outside the Union affected by a major disaster can make an appeal for assistance through the ERCC. It acts as a communication hub at headquarters level between participating states, the affected country and dispatched field experts. It also provides useful and updated information on the actual status of an on-going emergency. Last but not least, the ERCC plays a coordination role by matching offers of assistance put forward by participating states to the needs of the disaster-stricken country.

[5] http://ec.europa.eu/echo/policies/disaster_response/mechanism_en.htm

- The Common Emergency and Information System (CECIS) is a reliable web-based alert and notification application created with the intention of facilitating emergency communication among the participating states. It provides an integrated platform to send and receive alerts, details of assistance required, to make offers of help and to view the development of the ongoing emergency as they happen in an online logbook.
- A training programme has also been set up with a view to improving the co-ordination of civil protection assistance interventions by ensuring compatibility and complementarity between the intervention teams from the participating states. It also enhances the skills of experts involved in civil protection assistance operations through the sharing of best practices. This programme involves training courses, the ***organisation of joint exercises*** and a system of exchange of experts of the participating states.
- Civil protection modules are made of national resources from one or more Member States on a voluntary basis. They constitute a contribution to the civil protection rapid response capability called for by the European Council in the Conclusions in June 2005 and by the European parliament in its Resolution in January 2005 on the tsunami disaster. The Commission together with Member States has identified 13 civil protection modules.

In order to improve the mechanism, training is performed based on civil protection exercises[6]. Most of these exercises serve as field tests which contribute to creating common understanding among the participating actors in such assistance operations and aligning procedures between the various participating countries. Exercises at EU-level are organised by the participant states with co-financing from the Commission. A call for proposals for exercises is published each year. The exercises allow the simulation of real-life situations and test the designed methods for contingency planning, decision-making, information provision to the public and the media and increase the level of preparedness. Exercises can assist decision makers to identify further training needs for their staff involved in operations, while lessons-learned workshops organised in parallel can serve as a forum to identify operational gaps to be improved.

Since the functionalities of the CIPRNet project are aimed to such decision makers, it is useful to identify their needs and whether such decision support tools can be used during these training activities.

2.1 Exercise Types

The EU CP Mechanism covers a variety of disasters[7], which can be:

- Natural disasters
  - **Floods**, earthquakes, forest fires, cyclones
- Manmade disasters
  - Environmental disasters (Deepwater Horizon, HU alkali sludge accident 2010)
  - Complex emergencies (Georgia 2008)
- Health emergencies
  - H1N1 crisis (medical support Bulgaria, Ukraine)
- Assistance to consular support
  - Terrorist attacks (medical evacuation Mumbai)
  - Evacuation of EU citizens from Libya and TCN from Tunisia/Egypt

[6] http://ec.europa.eu/echo/funding/opportunities/calls/2013_call_CP_Mechanism_Exercises_en.htm

[7] http://ipsc.jrc.ec.europa.eu/fileadmin/repository/sta/cinet/docs/erncip/downloads/operators/European-Civil-Protection_.pdf

For the above threats, exercises are designed, but their type can also vary in terms of detail and execution. There are three types of exercises[8]:

- **Field Exercises** (FE) are replicating one or several phases of an emergency and involve several actors, some of which are deployed to the field (rescue teams, medical teams and so on). All the functions (operation, command, logistics, communication, public information, etc.) of a real operation are replicated and played in a coordinated way. Such exercises are designed to resemble closely to the real operation and usually the exercise is preceded by a table-top exercise (TTE), and includes a command post exercise (CPX) part. In some cases, these types of exercises are referred to as Full Scale Exercises (FSE).
- **Command Post Exercises** (CPX) aim to test the decision making structures in place, simulation a real scenario. They may include a minimum and focused deployment in the field of a number of actors. Such exercises are aimed to test the existing plans and tools on a higher level and identify problems in communication, coordination or execution of the plans.
- **Table Top Exercises** (TTE) or other type of discussion-based exercises can also be used. These exercises are designed to put real crisis managers in a situation to use existing plans and procedures to take decisions according to a proposed scenario. They do not require any deployment but gathers actors in one single location, where they go through in theory what actions they would take and how they would apply plans.

The call for proposals of such exercises defines that the scenarios that can be chosen are describing some kind of disaster, where the affected country cannot cope with, so it requests for assistance. The scenario can test the alert/request for assistance channels and tools, but it can also extend to actual operations.

Common structures and roles used in such exercises are the following[9]:

- Reception and Departure Centre (RDC): This is a gathering place where the foreign assistance units receive their initial instructions after arrival and registration.
- On Site Operations and Coordination Centre (OSOCC): A Coordination centre for the deployment of foreign assistance teams. This coordination centre offers support to the local authorities in the disaster relief in terms of the deployment of the foreign assistance units.
- Local Emergency and Management Authority (LEMA): This is the international term for the (local) authority responsible for dealing with the disaster (control of the disaster relief).
- On-Site Commander (OSC): This is the international term for the commander (operational leader) at the place of the incident.
- Base of Operations (BoO): Base camp for the foreign assistance units. This is the base camp where the foreign units have gathered their personnel and from where they depart for the location where they are deployed.

---

[8] http://ec.europa.eu/echo/funding/opportunities/calls/2013_call_CP_Mechanism_Exercises_en.htm

[9] Derived by the description of the FloodEx 2009 exercise found in: R.J.J. Beerens, B. Kolen, I. Helsloot, EU FloodEx 2009: An analysis of testing international assistance during a worst credible flood scenario in the North Sea area, in lood Recovery, Innovation and Response II, WIT press, 2010, pp. 241-255.

2.2 Activations

Since 2007, the mechanism has been activated for various types of incidents[10]. Among these, there are several cases of real flooding scenarios in countries within and outside the EU. For example, the mechanism was activated due to flooding on 07.12.2010 in Bosnia and Herzegovina and on 08.12.2010 in Montenegro. In the first case, the affected country requested high capacity pumps, water distribution items, boats, rubber boots, sand bags and received assistance from Austria (30.000 sandbags), Slovenia (6 mobile generators, 5.000 sandbags, 200 rubber boots), while a MIC Liaison Officer was deployed to Sarajevo for contacts with the Government. Similarly, assistance was provided to Montenegro from Belgium, Austria, Poland, Slovakia, Greece, Slovenia, Italy, Czech Republic and France, which included power generators, mobile generators, mud water pumps, manned rescue team power stations, lighting sets, raincoats, sandbags, tents, blankets, portable beds, first aid kits, rubber boots, boats with motors, kitchen sets, sleeping bags, mattresses, etc.

Damages in such cases are assessed in terms of the number of casualties/injuries, number of people displaced, missing or in need of evacuation, number of residential properties flooded, number of livestock injured/deceased, as well as damages to key infrastructures, including destroyed life support facilities, motor and rail ways, bridges, water supply systems, and agricultural lands. Other affected infrastructures can potentially be electricity, gas, water/sewerage, telecommunications facilities, etc[11].

3 Timelines in crisis scenarios and scenario evolution

ENISA has published a good practice guide for National cyber crisis exercises[12]. While the purpose of these exercises, and thus the guide, are different by the CIPRNet scenarios, some of the recommendations can be applied for any CI scenario design. The guide also highlights the need for a clear and definite purpose to be identified early on, before proceeding with designing the scenario. When the various storylines are formed it should be clear why they were selected and why they are required (for example, which functionality they are used to test and why specific parameters on their design were selected). Another useful recommendation is to involve key participants on the design phase.

Several exercises also present interesting graphical representations of the scenario planning. For example the exercise GRidEx 2011[13], organised by the North American Electric Reliability Corporation (NERC), presents the following timeline which depicts both the events of the exercise and the responses of the participants. A similar approach could depict key events for each CIPRNet scenario and either the response of CI operators or of the behaviour of key CI which will be simulated.

---

10 http://ec.europa.eu/echo/files/policies/disaster_response/EUCPM_activations_since_01012007.pdf

11 Post-Impact Assessment Checklist (p.74) in: http://www.em.gov.au/Documents/Manual%2022-Flood%20Response%282%29.PDF

12 http://www.enisa.europa.eu/activities/Resilience-and-CIIP/cyber-crisis-cooperation/cce/copy_of_exercises/national-exercise-good-practice-guide/at_download/fullReport

13 http://www.nerc.com/pa/CI/CIPOutreach/Pages/GridEX.aspx

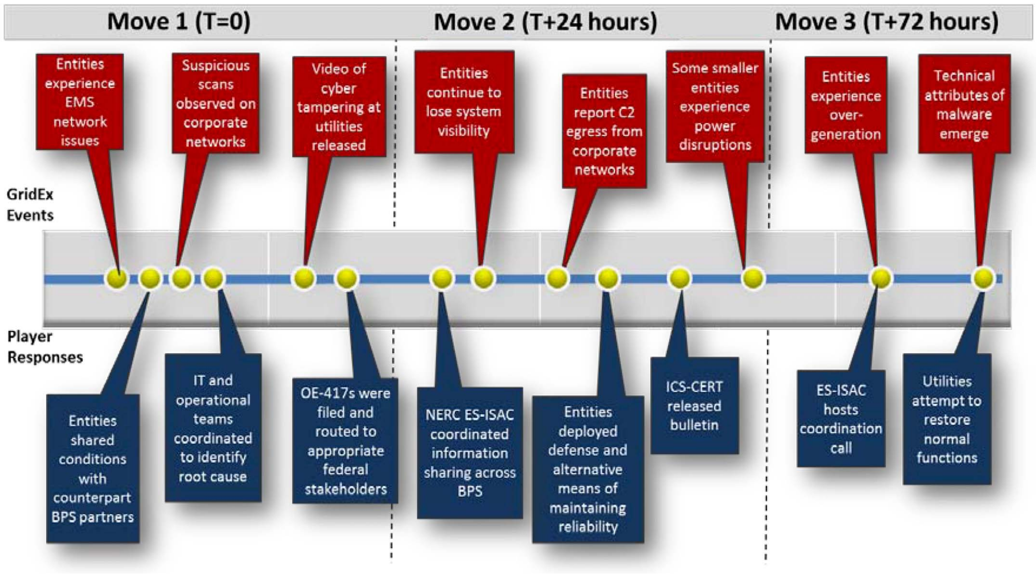


Figure 28: GridEX2011 Scenario Timeline[14]

The follow-up exercise GRidEx II, examined a combination of severe physical and cyber security attacks and presented a more comprehensive timeline, in the sense that the status of the Grid Reliability as the scenario evolved. Such an approach can be also used for selected CI that are affected by the CIPRNet scenarios and their **operational status** can be graphically depicted.

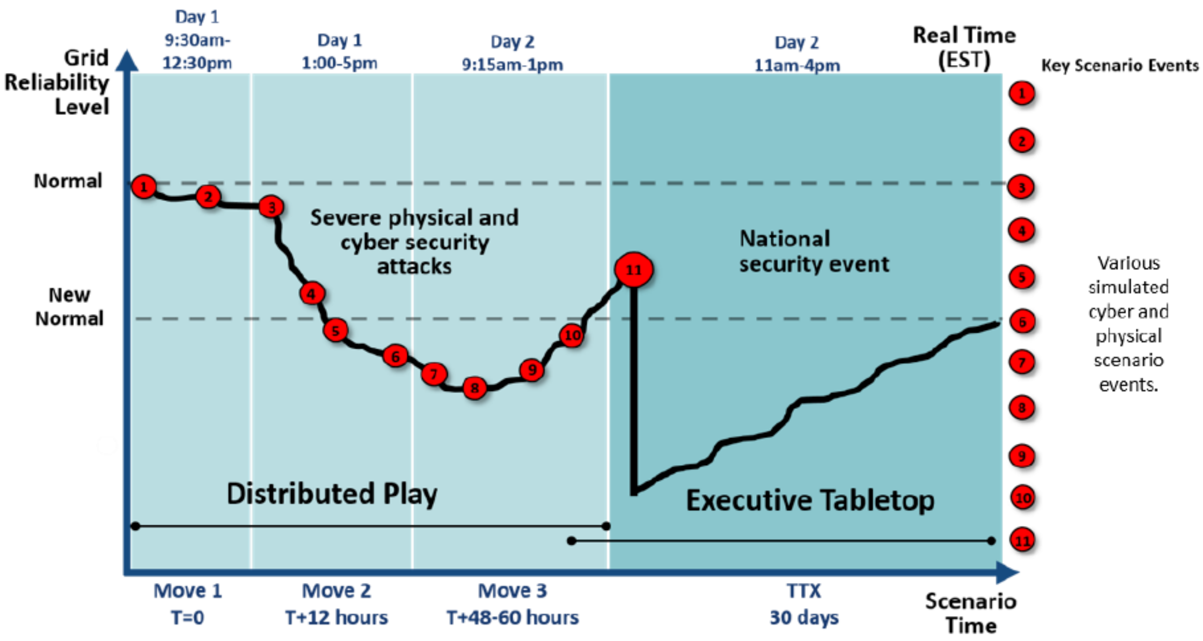


Figure 29: Grid Reliability Level over time[15]

[14] The figure has been retrieved by the 2011 NERC Grid Security Exercise- After Action Report (March 2012). http://www.nerc.com/pa/CI/CIPOutreach/GridEX/NERC_GridEx_AAR_16Mar2012_Final.pdf

[15] The figure has been retrieved by the Grid Security Exercise (GridEx II) After-Action Report (March 2014). http://www.nerc.com/pa/CI/CIPOutreach/GridEX/GridEx%20II%20After%20Action%20Report.pdf

Exercise COMMON GROUND[16] examines Europe's ability to respond to a health-related crisis. It was performed as a 2-day Command Post Exercise (CPX) in November 2005, but it reflects a 26-week period of pandemic influenza. The exercise used **time compression** to enable several events to develop and it was delivered in three blocks of time to reflect the different phases of the pandemic cycle (depicted in the following figure).

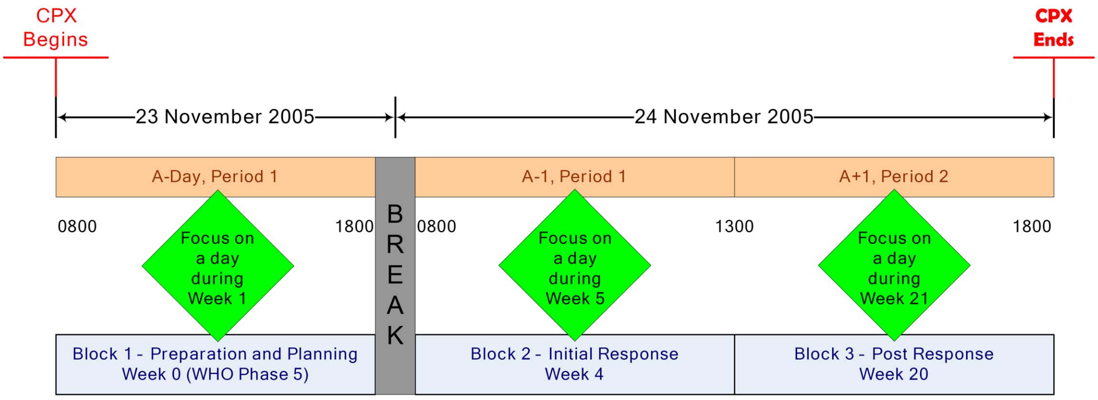


Figure 30: Common Ground scenario timeline[17]

During Block 1, strains of pandemic influenza from two patients are detected in Thailand and national authorities in all participating countries implement preparedness measures. Block 2 marks first indications of influenza activity in the EU and the initial response activities, while during Block 3, millions of new cases of influenza are occurring every week. The influenza affects all countries and effects to commerce and industry are identified.

Another example of visual representation was the maps used in the TRIPLEX 2013 exercise[18]. In the exercise scenario, two neighbouring countries called Nordland and Sydland are struck by a major cyclone, resulting in almost one million people affected, 5.000 people dead or listed as missing and 50.000 have urgent need of shelter, water and food. It was managed by the Danish Emergency Management Agency (DEMA) and the German Federal Agency for Technical Relief (THW). While additional information was not available at the time of the report, of particular interest are the maps showing road damage, medical facilities and potential impact of oil damage in the area.

Similarly the international exercise Twist (Tidal Wave In Southern Tyrrhenian Sea) provided interactive visualisation instead of a static map. The scenario describes a landslide in the submarine volcano Palinuro which triggers a tsunami wave, affecting residential, industrial, port, agricultural areas and cultural heritage, mainly in the province of Salerno. The consequences of the scenario list several victims or people in need of rescue both at sea and on land, several boats sunk or damaged, spills of polluting materials in the open sea and near the coast, blocked roads, flooding and blackout. The provided map[19] depicts (a) points of rescue activities (aid to the sea, divers, speleologists, CBRN teams), (b) points of assistance (medical care, identification of victims, evacuation, veterinary care, (c) points of cultural heritage or

[16] http://ec.europa.eu/health/ph_threats/com/common.pdf

[17] The figure has been retrieved by the Exercise Common Ground Final Exercise Report (Serial 5.0, Part 4, March 2006). http://ec.europa.eu/health/ph_threats/com/common.pdf

[18] http://www.mapaction.org/deployments/maps.html?deployment_filter=222&section=0

[19] http://www.protezionecivile.gov.it/jcms/en/view_dossier.wp?request_locale=en&contentId=DOS41849

environmental interest, as well as (d) the location of Command and Control Headquarters, Local Operations Centres, Mixed Operations Centres and Aid Coordination Centres.

The EU co-financed Exercise Orion (September 2010) examined the response to an earthquake scenario, which was selected as it is considered to be an event of very low likelihood but of high impact in the UK. The goal was, therefore, to test the event "outside normal planning assumptions". An interesting aspect of the scenario was that the operational processes were followed as normal, but the timelines for the field exercises were again very compressed, like the case of Common Ground exercise. In terms of providing realistic information for the players of the exercise, they were provided views of a Geographical Information System (GIS) but on various levels of detail: local, regional and national level. The field exercise tested response to several cases, which could be used to enrich the CIPRNet scenarios, even if the initiating incident differs. Examples include the collapse of various types of buildings (office block, apartment block, refinery), or infrastructures (bridge, oil-storage tank farm, road tunnel), causing fatalities, casualties, trapped survivors, fire or contamination to oil and water supplies through possible contamination, with the goal to put pressure to rescue team due to the simultaneous occurrence of the events due to the common cause of the earthquake.

4 Flood-related Scenarios

This Annex presents the descriptions of the exercises examines as retrieved by the available material. Some minor editing and structuring has been performed in order to unify the presentation of storylines, remove unnecessary information and correct minor mistakes. Each scenario is followed by a 'comments' section that summarises initial findings and observations related to the exercise.

4.1 Danubius 2009

The Danubius 2009 exercise[20] takes place in Romania and was based on an earthquake incident, but with complex consequences of a natural disaster, a radiological and chemical incident, as well as the potential consequences on critical infrastructures. The case was selected as Romania is highly vulnerable to earthquake and flood. It was included in this report, as some of the field exercises described could be useful for the CIPRNet flood scenario.

4.1.1 Storyline

In the early morning of September 8th, at 02:47am, an earthquake occurs having a magnitude of 7.9 on the Richter scale and the epicentre in Vrancea area. Its consequences are catastrophic, the most damaged areas being the capital of Bucharest and the Giurgiu Municipality, situated at 55Km South of Bucharest, on the Danube's bank. The Romanian authorities performed a preliminary assessment of the earthquake consequences whose results reveal such an extent of the damages that the national response capabilities are totally overwhelmed, rising an urgent need of international support in order to properly and efficiently cope with the situation.

The National Committee for Emergency Situations decides to activate the European Civil Protection Mechanism on the basis of the preliminary assessment outcome. Following that decision, till noon, IGSU sent a request for assistance to EU-MIC, through CECIS. The re-

[20] The description of the exercise was based on a report by the Romanian General Inspectorate for Emergency Situations, published June 2010 and available here: http://www.igsu.ro/documente/SAEARI/Danubius.pdf

quest for assistance specifies that there is an urgent need for international assistance in the Southern part of Romania, especially in the capital city of Bucharest and the Giurgiu municipality.

4.1.2 Exercise structure

The exercise was conducted as a Community assistance operation in response to a major disaster in a Member State with severe consequences on the national and European infrastructure, in the framework of the Mechanism's regulations. It took place from the 9th to the 12th of September 2009 and consisted of three parts:

- A command post exercise focused on the phases of preparation and Mechanism activation, where the target audience was represented by the National Points of Contact and decision-makers, supported by the EU-MIC.
- A field exercise, comprising of the transit, arrival, on –site operation and pull-out phases, where the main focus was on the cooperation capabilities and interoperability of the teams, the EU civil protection experts' coordination capacity and skills, the use of internationally recognised provisions, guidelines and procedures for disaster response operations.
- An evaluation workshop on the last day of the exercise, where the target audience, represented by EU civil protection experts, observers, team leaders, liaison officers as well as the planners, had the opportunity to develop a hot-wash type workshop in order to identify lessons learned.

The field exercise took place in four sites. The first site allowed training on response operations for the **earthquake consequences**, such as search and rescue activities, with the aide of Germany, Romania and Hungary.

The second site was dealing with **effects to other infrastructures**, such as industrial facilities using/producing toxic chemicals. The following chemical accidents were exercised: Decontamination, SAR and heights rescue in contaminated environment, medical assistance, first assessment and CBRN research, fire engine for fire extinguish with water and foam, water supply for decontamination unit.

The third site included **response actions to various incidents involving critical infrastructure**, such as an incident occurring on the RO/BG bridge[21], involving chemicals and passengers' transport, water rescue with helicopter, de-pollution operations, chemical research, evacuation from the contaminated area and water supply for the decontamination unit, decontamination, lighting, water rescue with boats and divers, medical emergency assistance and medical evacuation.

Finally the fourth site exercised **response actions to Incidents in fuel supply station** for river ships and major fire, water rescue with divers, medical emergency assistance and medical evacuation and major vegetation and forest fire.

4.1.3 Exercise Map

The following picture depicts the various sites which were activated during the exercise:

[21] The incident on the bridge was not described in detail, but it is assumed that the bridge suffered structural damage due to the earthquake.

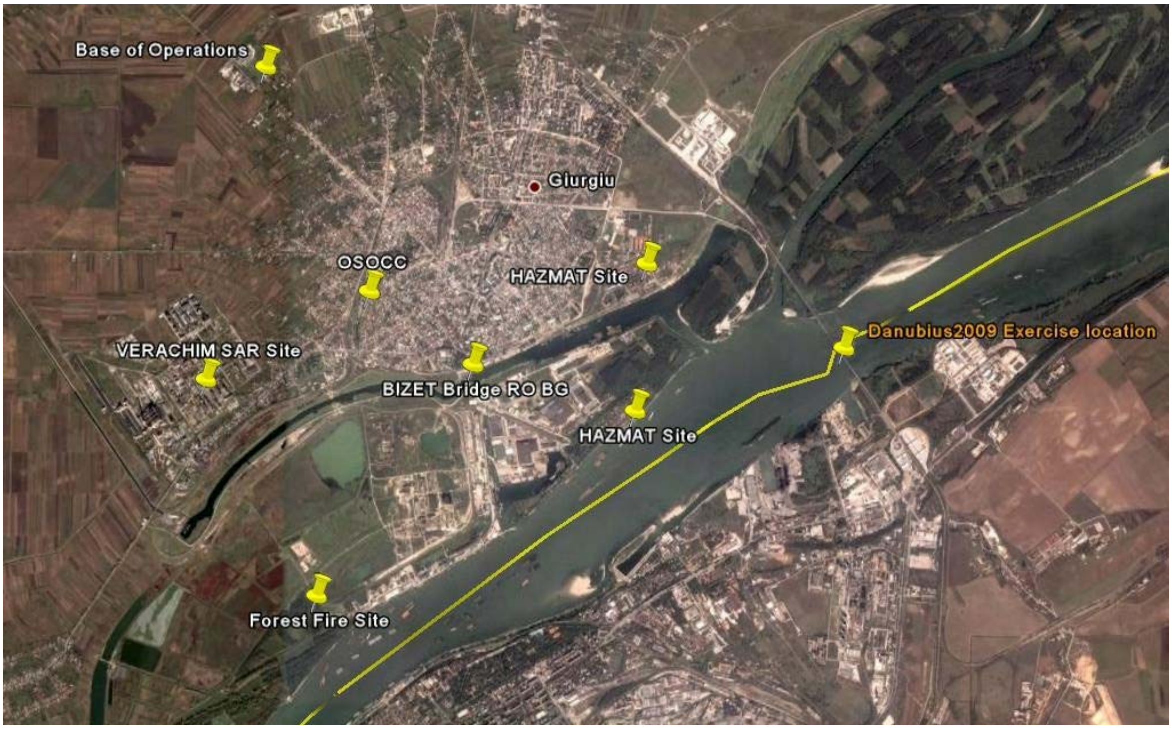


Figure 31: The Danubius 2009 Exercise locations[22]

4.1.4 Comments

The Danubius 2009 storyline is quite brief in its description, as it does not depict the scenario in detail and in particular phases (the timeline of the incidents remain uncertain). The exercise is mainly focused on the procedures required in order for the Mechanism to be activated, as well as field exercises to test the cooperation and effectiveness of the various deployed teams in various scenarios. However, the exercise considered the immediate effects of the initiating event (earthquake), such as the search and rescue of civilians, as well as the potential consequences to critical infrastructures, even if the incidents leading to the particular field exercises were not described in detail. More specifically, it considers effects of a chemical nature to the environment and the public, as well the combination of a fire, which could be combined with the CIPRNet scenario.

While the assistance is provided by several countries, the effects of the earthquake remains local; this differentiates this scenario from the following ones.

4.2 FloodEX 2009

This was an exercise[23] which aimed to test the recently developed procedures concerning incoming foreign assistance in the Netherlands during a **worst credible flood**. It was decided

---

[22] General Inspectorate for Emergency Situations, EU-DANUBIUS 2009 report, Romania, June 2010. http://www.igsu.ro/documente/SAEARI/Danubius.pdf

[23] The description of the scenario is based on information provided in [Beerens1] and in the following documents:

EU FloodEx 2009 - Field Exercise Evaluation Report, Netherlands Institute for Safety Nibra, Final Version, 18 November 2009.

P. Hayden, EU FloodEx 2009 - UK Evaluation Report, Hereford and Worcester Fire and Rescue Service, 25 March 2010.

that the worst credible flood scenario[24] should be chosen and that it will focus on a situation with shortage of almost all available means.

The exercise was organised as follows:

1. Command Post Exercise (CPX): A two day international exercise from D-1 to D-0 (the flood starts at midnight) for national decision makers to apply for and respond to international assistance.
2. Field Exercise (FE): A four days international exercise starting at D+2 with focus on the aspects of cooperation under Community Civil Protection Mechanism after a large-scale flooding. The overall objective was to train and to improve existing procedures of alerting, mobilising and dispatching civil protection intervention and expert teams in case of disasters.

4.2.1 Storyline

The development of the scenario used for FloodEx was based on the experiences of the flood in 1953, the Dutch exercise ‘Waterproef’ and scenarios as ‘Worst Credible Flood’ and Evacuation in The Netherlands, H19 in United Kingdom and expert opinions.

The scenario describes a storm surge in the North Sea, in which the area is hit by a severe depression with extreme wind velocities, coinciding with spring tides. This combination of natural events leads to extreme high water in the United Kingdom and The Netherlands and high tide in Germany that causes high water levels in estuaries.

For the exercise a scenario was developed that described the development of the threat starting 6 days (D-6) before the flood (D-0) up to a few days after the flood.

4.2.1.1 Day -6

The scenario starts when meteorological and flood-forecasting experts detect the possibility for extreme weather (and flooding). The actual weather at that time, and the forecast for the following few days are ‘weather as usual’. Only experts are able to clarify why some conditions above the Atlantic Ocean that might cause extreme weather in the nearby future. At this moment (D-6) it is foreseen that a flooding could occur over 5 to 6 days because of the storm surge and high tide. The probability for flooding is low, about 5%. The development and direction of the depression and the combination with the local tide on sea is very uncertain. Flooding can only occur in very specific conditions as extreme wind above the North Sea region with direction northwest.

After detecting the possibility of extreme wind (by meteorological offices) and a possible flood situation (by Flood Forecasting Centres) on D-6, the crisis centres will be alarmed. The crisis structure of local, regional and national authorities is started up. As a result, the national government gives instructions and guidance to the regions in order to prepare evacuation planning. In addition they set out guidelines for decision-making and business continuity in the threatened area. National organisations give instruction and guidance to the regional and local organisations to make a decision about a preventive or vertical evacuation based on the consequences in the whole affected area. At D-6 national organisations prepare themselves for possible decisions for evacuation on D-4. All partners develop an overall strategy combining national and regional planning and assistance (within a country).

[24] Worst Credible Floods give an upper limit of flooding scenarios that is still considered realistic and credible by experts, and that can be used for emergency planning in addition to other less extreme scenarios.

4.2.1.2 Days -5 to -1

In the following days the probability slowly increases to 15% at D-4. At D-1, at the start of the storm, the probability further increased up to 40% in the morning and 55% in the afternoon. These are akin to a genuine scenario.

The exercise scenario postulates that the threatened area after detection (D-6) is the entire North Sea area that is flood prone due to a storm surge (United Kingdom, Denmark, Germany, The Netherlands and Belgium). The exercise also suggests that the Netherlands and the United Kingdom may experience an impact that exceeds the flood of 1953. For the Northern part of Germany there was a high risk of overtopping of dikes and river flooding caused by extreme seawater levels. The development of the flood in The Netherlands after the dike breach for the first day is shown in Figure 2.

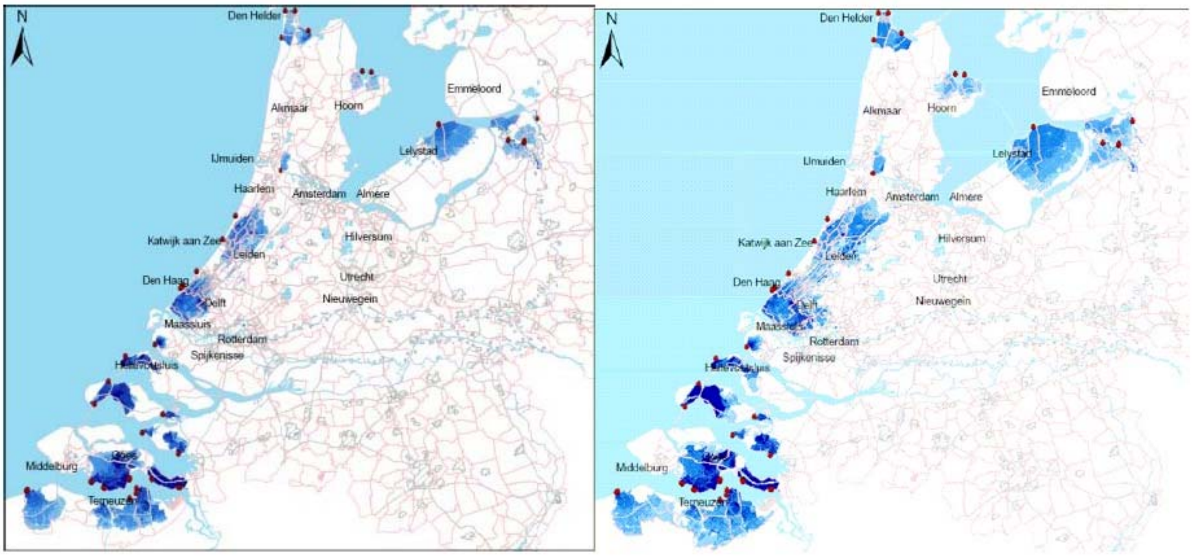


Figure 32: FloodEx 2009: Flooding maps (Source: [Beerens1])

At D-4 the first decisions are made for evacuation of the most vulnerable, measures for infrastructure protection and business continuity. Decisions to evacuate those who are self-supporting are postponed a day to wait for the development of the threat.

At D-3 the probability has not declined so the **evacuation** of the self-supporting is initiated. Some people self-evacuate and leave the threatened area, whilst others prepare themselves inside their homes or in relief centres for the public (such as community centres). National and regional traffic management plans are implemented to facilitate the evacuation. After D-3 regional authorities start emergency planning for possible rescue operations after a flood.

The time available for proactive or precautionary evacuation is approximately 33 hours after the decision is made, which includes the implementation of **traffic management** measures for evacuation. It will not be possible for all people to evacuate ahead of the predicted floods due to the limited capacity of infrastructure. Those not evacuated (which may include local businesses) are assumed that they will support themselves for 72 hours starting from D-1.

At midnight of D-1, **overloading on the highway networks** hinders the evacuation.

Additionally, during D-1, extreme wind speed makes outdoor areas too unsafe to travel through. According to the scenario, 1.4 million people succeed in evacuating the affected areas; however, there are an equal number still is in the flood zone. These people are either in a relief centre, in their homes, or elsewhere.

4.2.1.3 Day+2

The scenario continues at D+2 and takes place at the Field Exercise locations in Noord Holland. Several parts of the west side of the Netherlands are flooded. As stated in the exercise description, it is assumed that the Netherlands will retain control over the response and therefore the local emergency services and the national disaster organisation are still (if partially) functioning. There is however a shortage of operational capacities and adequate information for defining needs assessments. Because of the scale of the flood, a comprehensive assessment of the need for help has not been carried out everywhere in the flooded zone and it is difficult to define the precise capabilities needed. However the local emergency management authority (LEMA) and International EU Coordination Team are coordinating the deployment of incoming foreign units on D+2 together with Dutch units at various locations in the northern part of Noord Holland (the Amstelmeer, Groote & Kleine Vliet and the Alkmaardermeer). During their deployment they are required to conduct various search and rescue activities and pumping operations. Their mission lasted for about two days according the scenario.

The field exercise starts one day after **the coast dikes have breached**. Several parts of the west side of the Netherlands are flooded. Most people are already evacuated out of the flood zone but several tens of thousands are still in these areas. Some of them are trapped in their flooded houses or on small pieces of higher land, whilst others have only a shortage of daily needs, like fresh water and food. A very small amount of people is **injured**, and some persons who have been in the floodwater are **contaminated by pathogens**, caused by drowned livestock.

The local emergency services and the national disaster organisation are still functioning, and the structure of command and control is intact. There is however a shortage of operational help. Because of the scale of the flood, an comprehensive assessment of the need for help has not been carried out everywhere in the flooded zone.

The Local Emergency Management Authority (LEMA) and International EU Coordination Team are installed in the National Operational Centre (NOC). They have identified several possible locations for a Base of Operations (BoO). One of them is a former military site in the area of the Safety Region1 Noord Holland Noord. To get the water out of the flooded zone into the sea, Dutch pumps will be installed on the North site of the Safety Region on the bank of the Amstelmeer near Den Oever and Wervershoof. There is a requirement for more pump capacity at these locations and a request for foreign assistance has been sent out.

The areas of Groote & Kleine Vliet and on the east site of Alkmaardermeer are flooded and a reconnaissance has still to be made of both. The flood blocks several roads. The Regional Operational Team (ROT) has identified passable routes and has been opening other key routes with the assistance of military engineers, using portable bridging equipment and pontoons. Limited military heavy lift capability is available by landing craft and helicopter."

4.2.1.4 Exercise Map

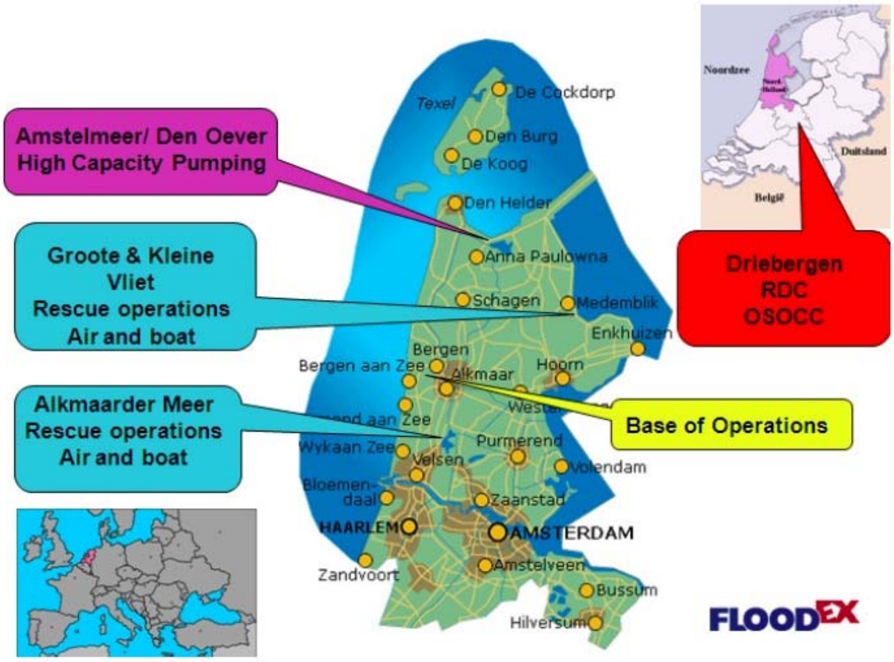


Figure 33: Overview of the exercise locations in the Netherlands (Source: [Beerens1])

4.2.2 Comments

The FloodEx scenario is interesting as it lists in detail the events that lead to the dike breaches marking the zero day of the exercise. Such a description could be useful for the CIPRNet scenario and this was the exercise closer to the possible scenarios discussed for the CIPRNet project. However, the FloodEx storyline does not describe in detail how the critical infrastructures of the area may be affected; these are not identified or assessed. The effect of evacuating population been hindered due to extreme weather and the limited capacity of the transport network is mentioned and it should be taken into consideration. The only infrastructures identified are the transport network, as well as the water network (possibly contaminated with pathogens from livestock).

The field exercises focus mainly on coordinating the rescue operations and pumping operations needed in order to mitigate the immediate effects of the flood, so it is expected that the decision makers will need information supporting these two activities. Some other key findings include the need to define the time window where a flood can be predicted in a specific area as this may vary (in the case of the UK it was referring to time needed to predict a likely coastal surge). This is necessary in order to define the time required to initiate mitigating actions, such as evacuation or deployment of rescue teams in advance. Also, the main burden of rescue operations falls on local resources, at least at the initiating phases, thus, they need to be identified beforehand.

The Flood Rescue activities include[25]:

- Immediate time critical rescues in the most challenging working conditions depending on specialist flood rescue teams and helicopters
- A larger number of rescues/recovery of individuals from places of temporary safety in inundated structures or vehicles over an extended period;

[25] These activities were identified by the UK Evaluation Report.

- On-going support to recovery operations, provision of essential supplies necessary to sustain those trapped in places of temporary safety; and
- Final wide area search, searching all damaged vehicles and structures, and recovery of bodies. This activity could involve specialist teams for a number of weeks.

The CIPRNet scenario should consider whether the information required in order to monitor the above activities can be incorporated in the simulation tools, as it would interest the decision makers. Other key factors that differentiate the outcome of the flood and may mark different branches in the storyline are the following[26]:

- Whether the event occurs during the day or night as this will dictate whether people are at home, work or in other structures, or likely to be in the open or on the roads.
- Whether the event occurs in summer or winter as this has a huge impact on coastal population levels and population vulnerabilities. Tourists not only swell the population but pose additional risks arising from lack of knowledge about the risks and local topography. There are also issues arising from the types of accommodation occupied by tourists, including caravans or other temporary structures offering little protection against an incoming surge. In the case of the CIPRNet scenario, some event that increases or modifies the population could be considered (e.g. a festival or convention).
- Whether the most vulnerable individuals or communities are evacuated effectively before the event[27].
- Whether water defenses are overtopped or fail entirely. Overtopping is likely to result in large areas of standing water for many weeks, whereas a failure of a defense will result in a tsunami like wave that is more likely to cause extensive structural damage. The CIPRNet team needs to examine whether the water simulation tools can provide such information regarding the impact of the flooding.

[26] Likewise, these recommendations are retrieved by the UK Evaluation Report.

[27] The UK Evaluation report defines that "evacuation" refers to the removal of individuals from an area at risk before the flood, either unaided or with the help of Local Authorities. Once it is unsafe for individuals to make their way from an area unaided, requiring their removal by boat or helicopter, this is no longer an evacuation; it has become a "rescue" activity.

4.3 Barents Rescue 2011

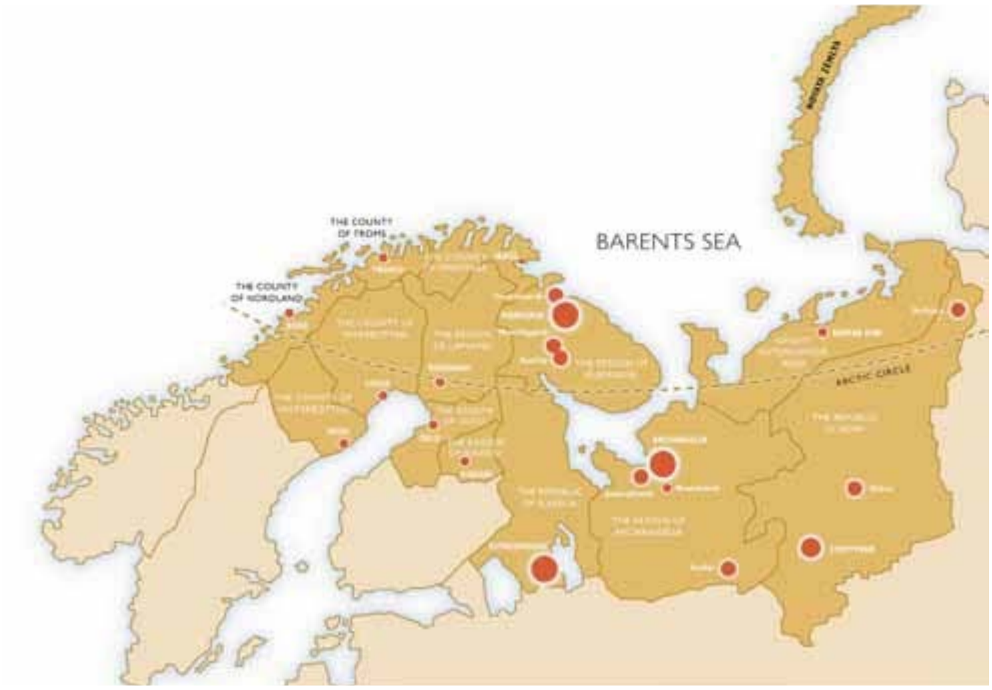


Figure 34: The Barents region (Source: Exercise Barents Rescue 2011 Report)[28]

Exercise Barents Rescue 2011[29] was organised by the Swedish Civil Contingencies Agency and consisted of a range of main and sub-exercises that aimed to develop the capacity to provide and receive international assistance in the event of disasters in the Barents Region. The sub-exercises were held during a period from April to September 2011. The main exercises were held on 21-22 September 2011.

The fictitious scenario for the Barents Rescue 2011 exercise was based on a **dam collapse** in the Lule River, which resulted in a number of incidents. The exercise was an opportunity to train and test various emergency response skills. Participants from the northern parts of **Norway**, **Sweden**, **Finland** and **Russia** were able to influence the type of incidents included in the exercise.

4.3.1 Storyline

The Barents Exercise storyline begins with a description of various international events that set the scene for this particular scenario and introduce the rationale of the scenario.

4.3.1.1 Preceding events

In a **fictitious reality** in the autumn of 2011 we found that a number of serious disasters have occurred around the world. In the wake of Haiti, Brazil, Chile, and Iceland, national and international emergency services were stretched to the limit and enormous resources were needed for societal infrastructure recovery. The international systems for risk assessment and emergency response, the UN and other organisations, indicated that more disasters were expected. This because the negative effect of global warming is leading to more natural disasters and an increased risk for environmental threats.

[28] This figure has been retrieved by the Exercise Barents Rescue 2011 Report of the Swedish Civil Contingencies Agency, Publ. no. MSB358 (January 2012). https://www.msb.se/RibData/Filer/pdf/26117.pdf

[29] Swedish Civil Contingencies Agency, Exercise Barents Rescue 2011, Publ. no. MSB358 (January 2012). https://www.msb.se/RibData/Filer/pdf/26117.pdf

Since early April 2011, **continuous rain** had filled the waterways in the **middle and northern Sweden**, a phenomena shared by almost whole Europe. The water levels were extremely high throughout the regions. The hydropower companies had increased the number of inspections of hydropower dams. In July 2011 the inspection of a hydropower dam in Vasterbotten County detected a leak, where water was flowing into the Ume River. The leak was stopped and a major incident avoided. However, one person was killed while repairing the dam site. The Swedish media and the media from some neighbouring countries in the Barents Region described the action taken by the responsible companies and by the authorities as a failure ("too little too late, just good luck that nothing more serious happened..."). The media pressure on the entities involved was immense and they had continued to report on the rising water levels in Norrbotten and Vasterbotten.

At the beginning of September 2011, a **large earthquake** hit a popular tourist area in Turkey (also affecting tourists). Turkey requested international assistance and many countries, including Sweden, offered to help. Emergency response teams departed for Turkey on September 12th (which is one day before the Day 0 of the scenario, corresponding to the Dam Failure). Due to the increased number of severe environmental incidents, national and international **emergency rescue units** have been engaged and sometimes have been **stretched to the limit**. The recovery of affected areas will take a long time and consume a tremendous amount of resource and requiring international assistance. Assessments made by the UN and other agencies indicate an increase of environmental incidents, even in areas previously assessed as being of low susceptibility.

4.3.2 Spring 2011

Due to heavy rainfalls in the middle and northern parts of Sweden (Svealand and Norrland) **large areas are being flooded and the fire brigades have been heavily engaged** since beginning of April. Especially in Västerbotten and Norrbotten counties (in Norrland) the previous winter was very severe. The spring and the ice melt resulted in severe flooding in April and May; the rivers most affected were Torne River, Kalix River, the lower parts of Lule River, Pite River, the lower parts of Skellefte River, Ume River - notably the unregulated River Vindelalven, and Angerman River.

Buildings, bridges, parks and roads located in low-terrain areas particularly those near the rivers sustained water damage and in some areas people were forced to move. Some roads are still closed. Many municipal fire brigades managed to handle the situation well with limited support from the Swedish Armed Forces (Home guard).

On May 5th 2011 in Alvsbyn Municipality (Norrbotten County along the Pite River) temporary flood barriers close to a residential area collapsed and two children drowned. This event led to major headlines and many questions were raised regarding the protection and reliability of temporary flood barriers. Many people also requested help from the municipality to build temporary flood barriers in their areas but they only received recommendations.

Landslides occurred in areas close to rivers. Farmers were affected in many ways; both regarding limited harvests, but also with flooded fields. Farmers asked the municipal authorities to provide new fields for their cattle.

Road traffic accidents (RTAs) were a serious problem. Approximately 25 serious car accidents with dead or severely injured persons, and many more were injured due to undermined condition of roads. The amount of water on the roads caused many cases of aquaplaning. In May a Spanish lorry coming from Finland and transporting hazardous materials was near to cause a major accident near Lulea. Bad tires in combination with a drunk driver, high speeds and water on the road surface make the vehicle out of control resulting in an overturned lorry of E4 motorway. Luckily no explosion or leakage of poisonous materials occurred. It was only luck that stopped the catastrophe.

The Swedish Transport Administration supported by the police issues regularly specific information about the roads condition. However, it seems that the traffic accidents continue to be a big problem. The police also obtained reports from the public about increased burglaries and looting in areas that were evacuated. It seems that the police have not enough personnel to match all these emergency demands. Many people have made complaints to insurance companies, which are unwilling to cover the cost of damages. The many unsolved issues have led to some newspaper headlines. Insurance companies use the media for distributing information to the public: Take preventive action is their main message!

During the whole timeframe, the Swedish Meteorological and Hydrological Institute (SMHI – a government agency under the Ministry of the Environment) has issued general forecasts and weather warnings as support to Swedish national, regional, local decision-makers and the public in general. Since April 2011, SMHI has issued three warnings of level 2 and four warnings of level 1.

Level 2 indicates a 10 to 50 year flow and implies danger to the public and great material damage and disturbance in the important community functions. Level 1 indicates a 1 to 10 year flow and implies some risk to the public and disturbance in some community functions. The SMHI's long term forecast for the summer predicts a continuation of high rainfall period and possibly an exceptional wet season. It is however a forecast and thus uncertain.

To support coordination of measures taken, MSB conducted a cooperation conference with the county administrative boards and some governmental agencies. The purpose was to coordinate public information and examine the preparedness and co-operational effectiveness of civil protection and joint emergency responses.

The MSB has also monitored the development of the spring flood by collecting data from the County Administrative Boards (CAB) regarding water discharges. This information has been compiled and submitted on a weekly basis to the Ministry of Defence. The MSB has supported the municipalities with specific extra resources, e.g. sandbags, temporary flood barriers and water pumps.

The impact of the flooding was however limited:

- drinking water was only slightly affected,
- contamination of water was limited,
- no hazardous substances (CBRN) incidents occurred,
- the health of the population was quite good with a limited occurrence of stomach-related illnesses,
- no sewage system collapsed,
- electrical power supply and telecommunications were only slightly affected,
- no major evacuations were necessary,
- the municipalities including the fire brigades handled the situation well,
- no major emergency situation occurred.

The severe spring flood situation was an issue on the annual meeting between the Nordic Directors General (DGs) for civil protection. The DGs have encouraged their organisations to cooperate on preventive measures when it comes to a flooding scenario. The duty officer at MSB has informed the MIC on the situation in Sweden but Sweden has not made any request for additional international resources so far. The EU MIC continues to monitor the situation.

4.3.3 Summer 2011

The first part of June started dry, but the rest of the summer was wet and cold. The precipitation amount has exceeded the maximum level in Norrbotten County since the start of weather observations more than 140 years ago and has been much higher than normal in Vasterbotten County. In some areas precipitation has been more than the three times greater than the normal value. The cooler than normal temperatures resulted in accumulation of precipitation in the form of snow in winter and significantly lower than normal evaporation during summer. This has led to extremely high discharge and water levels in the rivers.

In early August the large regulation reservoirs were filled to their full supply level (FSL). In order to maintain the safety margins of the dams the floodgates were opened to release the surplus water downstream. As a consequence the resulting water flow in the lower parts of the rivers reached the 50-year values in many places. Decisions have been heavily questioned by those affected and some people have raised financial complaints. The municipalities and county administrative boards (CAB) have examined and updated their plans for handling the flooding situation. Extra temporary flood barriers have been obtained. Public relations officers have been active in disseminating information. Routines for public warning systems have also been examined. Some of the municipalities have contacted the Swedish Government with financial complaints for extra costs for flood measures. No decision has yet been made by the government.

4.3.4 September 2011

The water level in the Lule River has increased very fast in the last few weeks and it is expected to reach up to 3 meters higher levels than normal in the coming days for some areas. The long term forecast from SMHI shows that the rainfall would intensify and increase in duration in Norrbotten county in the first half of September. In the 90-day SMHI forecast however Norrbotten and Vasterbotten counties can expect temperatures near-normal to a little cooler than normal for the period, along with normal rainfall for Norrbotten and below-normal rainfall for Vasterbotten. The second half of September looks to have near-normal temperatures with rainfall near normal in the Norrbotten and near to below normal in the Vasterbotten County. October temperatures and rainfall look near normal for both Norrbotten and Vasterbotten counties. For November, temperatures look below normal with rainfall also below normal. It is worth mentioning that the 90-day weather forecast is just the start of the forecast process or first approximation. It will have to be further refined in the months ahead based on other contributing meteorological factors.

The Norrbotten CAB extended attendance of their meetings to include representatives from the municipalities and insurance companies, followed by increased public information work. The municipalities are also stepping up their efforts: Analysis of lessons learned from the spring floods, mapping probable land- slide areas and assessing available resources for the handling of flooding emergencies. Many municipalities have extended public relations service with specific public information centres (PIC). A growing task for the fire service is to rescue civilians trapped in motor vehicles in deep water.

During the summer, the Swedish Transport Administration, conducted several examinations of roads and railways and performed a safety supervision of companies involved. They have recommended the closure of some roads and railways. The railway used by Luossavaara-Kiirunavaara AB (LKAB, an international high-tech mining corporation) for ore traffic from Kiruna to Lulea Harbour is closed at Nattavaara. The traffic is routed to Narvik Harbour and is running with a reduced capacity.

Norrbotten County Council (local health authority) has also increased its readiness and public relations work. They are also supporting the municipalities and Norrbotten CABs with advice and recommendations. The Swedish National Food Administration (NFA, a government authority) has issued instructions to municipalities to increase inspections of abattoirs, butchers, dairies and poultry farms and also food facilities in trains, aircraft and on certain maritime vessels. The NFA has also issued advice to regional and local supervisory authorities and to the food processing industry. The NFA has also the overall responsibility for export inspections. As a part of import control, the NFA offices at the Border Inspection Posts carry out regularly test and sampling of food coming from the countries outside the EU for different infectious diseases like salmonella.

The MSB supports other authorities with expertise and advice. It has been in close contact with other national authorities and also with the private sector. The MSB has initiated discussions with the Swedish Armed Forces regarding the possibility of support in the form of transport resources (mainly helicopters and aeroplanes, but also tracked vehicles) and man-power from the Home Guard for various tasks, so far no decision has been made.

The MSB general assessment, based on the facts from national authorities and the dam owner companies, is that it will be a tough autumn ahead with increased flooding. MSB's estimation is however that it will be manageable with the available resources. The anxiety seen among people in the affected areas is increasing. The regional radio network of Sveriges Radio (SR, PBS radio in Sweden) in Norrbotten County has started a daily programme on the effects on daily life. Many questions have been raised by the listeners and SR used to invite representatives from authorities, the private sector and insurance companies to answer the questions. The extremely high water levels in the river system and the increased discharge of surplus water from the reservoirs cause more and more problems for the public. Cellars and basements are flooded and drinking water systems are contaminated by sewage water. Some municipal offices are also concerned about the risk of water seepage into their basements where their computer servers are located.

4.3.4.1 Health and Safety Effects

In some municipalities the decision has been taken to prepare evacuations of residents from affected areas. The municipal offices are receiving increasing numbers of telephone calls from residents and local businesses regarding support for the transport of properties and cattle out of the affected areas. Elderly people's home run by municipalities are requesting assistance to deal with the flooding that is polluting drinking water, causing power cuts, and not least causing anxiety and frustration among the elderly and their relatives. More and more calls are also received from people who are uninsured or have limited insurance; they are now turning to the municipalities for financial assistance.

At Sunderby Hospital (a county hospital on the border between Boden and Lulea) the flooding caused severe problems. The surgical operations are hampered due to temporary power cuts and water flood. On 9th September an outbreak of salmonella was detected at a clinic in the Norrbotten County. Incidents of diarrhoea are reported more frequently in the Norrbotten County and directives are issued by the local health authority regarding preventive hygiene.

The head teachers of some schools have allowed pupils to stay at home due to the risky transport to and from school and due to reduce the risk of contagion. Some farmers are facing problems with cattle drinking polluted water. Farmers are experiencing problems with power supply for their stables the reoccurring power shortages have affected the resilience of their back-up systems and the transportation difficulties have caused gaps in fuel deliveries. There are also disturbances in milk deliveries, which have forced the farmers to spill the milk in the sewage. The Swedish Board of Agriculture has released information on measures to prevent the spread of contagious animal diseases. Through the organisation of district veterinarians animal health care is ensured. Directives for preventive animal health care are issued. These are related to the environment, seeds and water, plant inspections and cattle registration. The Swedish National Veterinary Institute (SVA) (a government authority) has issued recommendations for managing animal diseases, particularly zoonotic diseases that can be transmitted between animals and humans.

4.3.4.2 Economic effects

Beside the hospitals, the electrical power is increasingly affecting the schools, farms, offices, shops and factories. The Swedish National Grid (the government authority responsible for electricity preparedness) supports different actors and contributes with several kinds of resources to reinforce the electricity supply system to ensure it is able to withstand this critical situation. Resources like emergency power supply units and tracked vehicles with operators, line poles, communication equipment, volunteers (operators, pilots) and so on are used. Some companies are facing problems with their computer server rooms, and from time to time their homepages are down. More and more shops are having problems with their cash systems, but also with equipment ceasing to work. They suffer also from shoplifting and burglary during the power blackout. Transportation of food from regional distributors to local shops is being hampered and even halted due to poor road conditions. Some factories report problems in receiving and distributing technical components.

4.3.4.3 Water contamination

The flooding has probably lead to contaminations in affected rivers as the chemicals used in households (e.g. paint, methylated spirits and acetone) are dispersed into the rivers and further into the Gulf of Bothnia.

4.3.4.4 Air and Sea Transportation Effects

Airport authorities report that flooding has reduced road capacity to and from the airport causing reduced operational capacity of Luleå Airport by 25 %. The Swedish Maritime Administration (SMA) has continued to keep the navigation routes open and safe. The SMA together with the Swedish Sea Rescue Society (SSRS) and the Swedish Coast Guard has conducted several maritime search and rescue operations in the Gulf of Bothnia. More and more residents and tourists from neighbouring countries like Finland and Norway are visiting the damaged areas that make the police work even more difficult.

4.3.4.5 Social Order Effects

In some areas in Norrbotten County, large numbers of foreign lingo berry pickers have showed up and used camping grounds with small cottages as temporary residences. Problems with informing these groups have occurred as some groups only speak Thai. At the same time, people are increasingly calling both municipal and county offices to offer their help, but with a limited response. In the media this is being reported as a failure by the authorities not accepting the assistance of those offering it. Moreover, some policemen have reported incidents where criminals have used dangerous laser pointers against police. After medical examinations, minor injuries to the eyes of the policemen were noted. In early September the police stopped a Finnish registered speedboat in Lulea Harbour, resulting in the arrest of a Swedish man and a Finnish woman. So far the investigation shows that those arrested were involved in illegal import of laser pointers from China to Sweden via Finland. They used Lulea Harbour and the Torne River as the gateway to Sweden. The Chief Constable in Norrbotten County has requested assistance from other counties with additional police personnel to maintain law and order in the area. The use of helicopters, both civil and military, has been limited because of the bad weather. The increased need for tracked vehicles with drivers is forwarded to Norrbotten County Administrative Board from the police and the municipalities. The road conditions are worsening and more and more roads (both gravel and metalled) are being closed for the traffic.

4.3.4.6 Telecommunication disruptions

Telecommunications are also affected by the flood situation and disruption to telecommunications has been reported in many rural areas. From time to time the switchboards at municipal and county council offices also have been blocked by too many calls.

4.3.4.7 Working conditions

Low-pressure system coming from the west has brought record rainfalls causing the water levels in the river systems and reservoirs reaching extremely high levels. As mentioned earlier, the hydropower companies continue with high discharge levels for the surplus water from the reservoirs. There are reports about overworking and stress related problems among municipal employees in Norrbotten CAB employees, particularly from switchboard operators. Some employees have also faced threats from angry residents. These employees have been working with flood related tasks without holiday since early May. The medical advice is that they need rest.

4.3.4.8 Psychological effects

During the summer, churches within the Swedish Church experienced the increased turmoil in the community. The needs for pastoral care and individual calls have increased significantly, talks about people´s anxiety, fear and anger. Many who live along the rivers have expressed their decreased confidence in insurance companies. People have tried to get help to protect their property from the water. More and more people express a sense of being abandoned. Everyone does not believe in authorities' assurance that it has the situation under control. People's concerns and anxiety for the future have also brought many existential questions, which deals with security in life and society. The parishes have been concentrated in worship, pastoral care, diaconal work, home visits and visits to nursing homes. Parish employees meet a lot of anxiety and anger mixed with sorrow. On-duty priest has also noticed an increasing number of calls, dealing with concerns about what will happen. The CAB of AC and BD have conducted cooperation conferences with regional actors addressing coordination of information and to examine the preparedness of civil protection capacities.

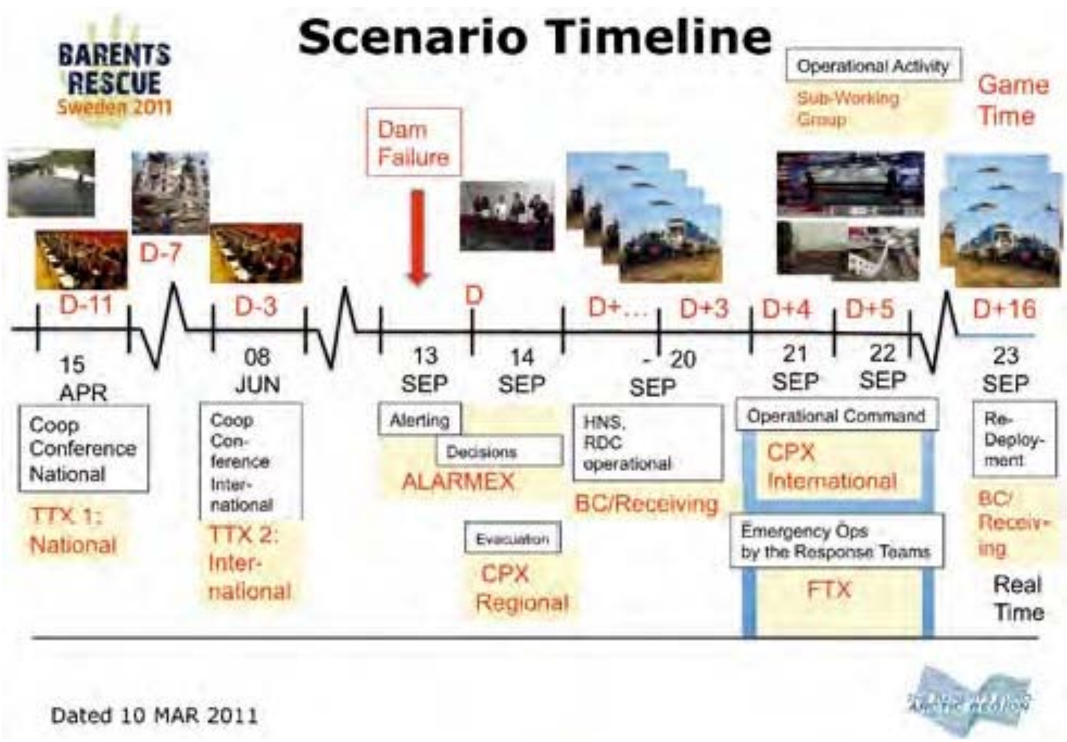


Figure 35: Barents Rescue 2011 Planning Timeline (Source: Exercise Barents Rescue 2011 Report)[30]

[30] This figure has been retrieved by the Exercise Barents Rescue 2011 Report of the Swedish Civil Contingencies Agency, Publ. no. MSB358 (January 2012). https://www.msb.se/RibData/Filer/pdf/26117.pdf

4.3.5 Exercise Plan

Barents Rescue 2011 consisted of a range of main and sub-exercises that aimed to develop the capacity to provide and receive international assistance in the event of disasters in the Barents Region. The sub-exercises were held during a period from April to September 2011. The main exercises were held on 21-22 September 2011.

The five **sub-exercises** were:

- Two Table Top exercises, TTX 1 and TTX 2, which should increase knowledge and capacities. TTX 1 focused on national coordination, whereas TTX 2 focused on international coordination.
- The Alarm Exercise, ALARMEX, which consisted of an alert phase and a decision phase.
- A Command Post Exercise, CPX REGIONAL, which aimed to test coordination in Norrbotten County in conjunction with the dam collapse.
- A border crossing and receiving assistance exercise, BC/RECEIVE, which aimed to test issues that arise when providing international assets and crossing national borders.

The **main exercises** were:

- An International Command Post Exercise, **CPX INTERNATIONAL**, which primarily aimed to test international cooperation at various staff and command levels
- A Field Exercise, **FE**, which primarily aimed to test international operational cooperation in the field.

Linked to the exercise was also a media play with the aim to give participating countries and organisations an opportunity to exercise their organisations in crisis communication, and to create a realistic and relevant challenge for working with media during a crisis.

4.3.5.1 Field Training Exercise events

The following exercises were performed:

- A **train accident** in Jokkmokk, mainly arranged with four train cars with dead and wounded people, of which two train cars had fallen downhill, extraction of trapped people, transportation of wounded people and search for missing people in the surrounding terrain.
- A **medical rescue exercise** linked to the train accident in Jokkmokk focused mainly on the transportation of wounded people, triage/medical prioritising and treatment, identification and registration.
- **Evacuation of patients from hospitals**, moved to Kallax Airport for transportation with the Swedish National Air Medevac (SNAM).
- A **tunnel accident** in Letsi, mainly arranged with trapped people and a **fire** deep in a tunnel.
- A **hazmat accident** in Boden with ammonia caused of a traffic accident between a cargo truck and a bus.
- A **maritime accident** in Lulea, mainly arranged as a boat collision with many people falling into the fast-flowing water.
- A **fire in the engine room of the icebreaker Atle** in Lulea harbour the lower decks were filled with smoke. Since there were people on board, a search and rescue operation was needed.

The locations of the exercises are depicted in the map below:

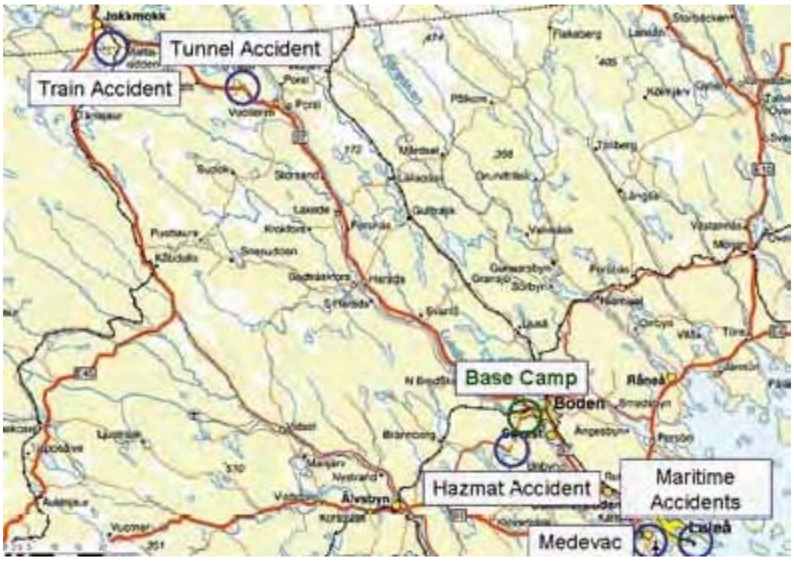


Figure 36: Barents Rescue 2011 Exercise Locations (Source: Exercise Barents Rescue 2011 Report)[31]

4.3.6 Comments

This exercise describes in high level of detail the impacts to the area in various time frames, which set the scene for the field exercises performed. While the time frame is not clear at several points of the scenario description, several effects on critical infrastructures are discussed. Examples include power disruptions, communication failures, or disruptions to medical facilities, either due to power outages or to flooding within the structures. The risk increase in the transport network is also highlighted and several accidents were selected as possible cases for field exercises. These include train, tunnel or road accidents, as well as maritime accidents. The case of a hazardous material (Hazmat) scenario was also exercised. The exercises selected are quite close to the ones exercised in the Danubius 2006 exercise, even if there the initiating event was an earthquake.

4.4 Taranis 2013:

During EU Taranis 2013[32] there were two different types of exercises planned:

- Command Post Exercise (CPX): 17th to 18th June 2013: The CPX is a planning scenario in which the coordination and cooperation of national warning centres will be tested. This will take place shortly before the Field Exercise.
- Field Exercise (FE): 27th to 29th June 2013: The FE is the operational part of EU Taranis 2013. It is in this part that the requested international assistance modules will actually be deployed and tested within the various exercise scenarios.

4.4.1 Storyline

Long lasting massive rainfalls in the western parts of Austria, especially in the Province of Salzburg, lead to regional floods, landslides, mudslides, rock-falls, etc. having an effect on many areas and a **heavy impact on the transport infrastructure**, which causes the need for

[31] This figure has been retrieved by the Exercise Barents Rescue 2011 Report of the Swedish Civil Contingencies Agency, Publ. no. MSB358 (January 2012). https://www.msb.se/RibData/Filer/pdf/26117.pdf

[32] All the information about the exercise were retrieved by the exercise website: http://www.taranis2013.eu

engaging national disaster relief units for several weeks. The culmination of the disaster occurs 14 days after the first flood. A new warm weather front from the northwest again brings strong rainfalls over a short period of time. This time the snow line is over 3,000 m above sea level. Consequently the huge amount of melt-water coming from the mountains becomes a problem. An extreme flood affects the Tiroler Unterland (East Part of Tyrol), South-East Bavaria, almost the whole Province of Salzburg, the west and south of Upper Austria and the north of Styria.

A major rock fall (several 1000 tons of stone and soil) in the area of the Pass Lueg (situated 30 km south of the City of Salzburg) blocks roads and leads to a damming of the Salzach River. The dam causes backwater in the Salzach River (SE of Pass Lueg). The damming causes flooding of both the A10 motorway and the railway tunnel south-east of Pass Lueg. The massive pressure on the dam caused by the backwater leads to a **collapse of the dam**. The breaking of the dam causes extensive flooding in the north-northwest area of the Salzach Valley affecting the area that spreads from the town of Golling (in the south) to the village of Oberndorf (in the north). The flooding itself and the landslides, rock falls, etc. triggered by the combination of river and mountain torrent flooding and massive rainfalls causes severe damage to infrastructure, property, transport, energy, industry, services, health care and drinking water supplies in the affected area including parts of the City of Salzburg.

Austria’s disaster relief organisations are mobilised by the Province of Salzburg Civil Protection Authorities and deployed to different areas where they start work. As a result the previous and on-going operations and national disaster relief resource capacities are overwhelmed. The Civil Protection Authorities of the Province of Salzburg and at a national level (Ministry of the interior) are continually assessing the situation and monitoring the overall development, and come to the conclusion that national resources cannot cope with this major disaster any longer without receiving international assistance. They activate the Community Civil Protection Mechanism.

4.4.1.1 Map

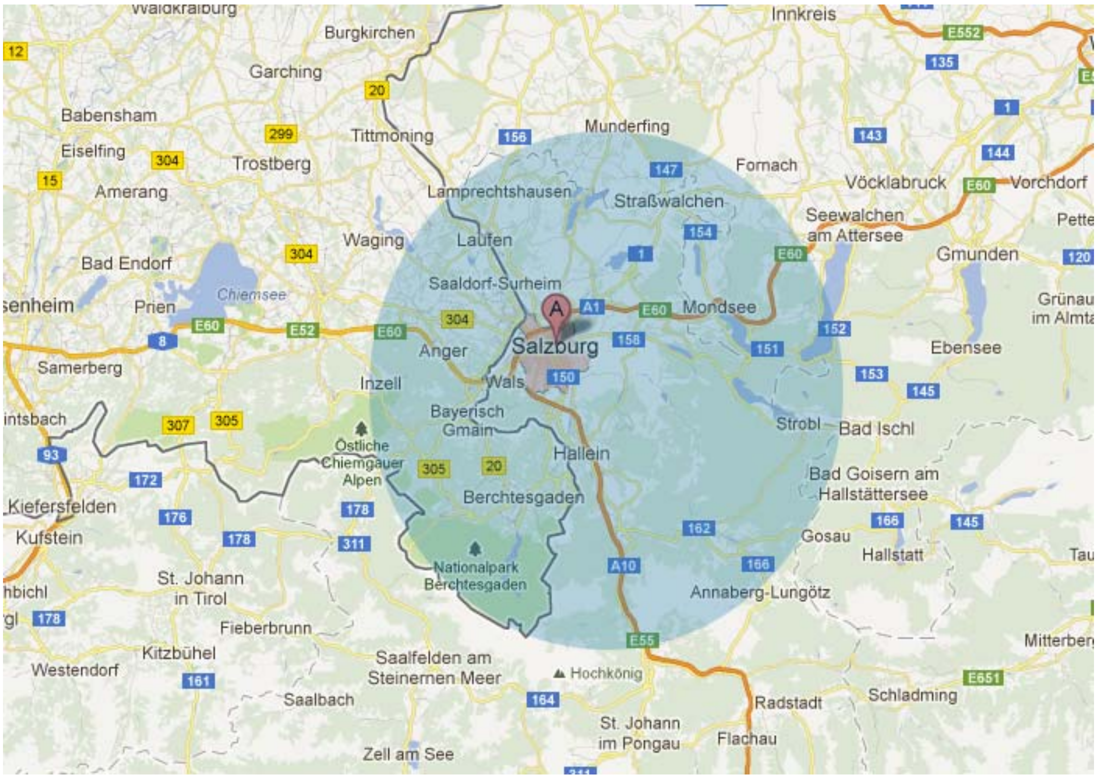


Figure 37: Taranis 2013 Exercise Locations (source: Google Maps)

4.4.1.2 Phases

The description of the scenario storyline was presented in phases:

First Phase

After a winter with a low amount of snow, rainfall during the months of April and May is above average (including within the mountain region of 2,000 to 2,500m altitude). Consequently there is a large amount of snow on the glaciers and the valleys from mid-level down to the foothills get soaked repeatedly.

The drainages carry a heavy load of melted snow and rainwater. The ground-water levels and soil saturation are at a high point. This has no major effects, since the intensity and dosage of the downpour are not unusual, but the amounts in total over a period of time reach a considerably high level.

Second Phase

The second stage of EU Taranis 2013 begins in June by which time a sudden weather change leads to extended and intensive downpours along the entire north-side of the mountain range. The rains fall up to a level of 2,300m and snow falls in the topmost mountain ranges. As a consequence isolated mudslides and flood waves occur.

Third Phase

After a few days the high water recedes. This is followed by a heavy cold weather front with short but intensive rains and severe thunderstorms. This creates local flooding of small streams and channels and numerous cellars get flooded.

Due to the fact that the soil had previously been soaked heavily, these local thunderstorms now cause clogging and a number of small-scale mudslides. Several streets get covered by mudslides and become impassable. A number of motorways need to be closed for extended periods, as the streets have become either undermined or washed away.

In the area of a natural constriction (Lueg Pass) between two mountain massifs, repeated rains result in a landslide that blocks the main road, railway and highway and causes the Salzach river to create a dam.

At this point all national catastrophe relief teams have already been sent into the affected areas and have now reached a level of exhaustion after the numerous missions during Phase 2.

Fourth Phase

The climax of the disaster situation occurs a week after the first flood event. A new warm weather front now brings with it heavy rains even in high altitudes. Due to the very large amounts of water pouring down from great heights, an extremely large-scale flood is being created, which affects several states.

The situation is aggravated by the already existing significant restrictions (mudslides, clogging, rockslide, etc.) that have arisen during the previous weeks. In the area of Pass Lueg, the pent-up waters keep bearing pressure on the wall that had been created by the rockslide, causing a break and a massive flood-wave.

The flood wave in interaction with landslides, rock falls, etc., leads to serious damage in transport, energy, trade and industry, health and primary care sector in the affected areas and in the city of Salzburg.

National organisations of fire fighters, the Red Cross and the Water Rescue team had been mobilised by the civil protection authorities of the Federal Province of Salzburg and were already engaged in combatting the various local catastrophes. The capacities of the national forces are exhausted and the disaster cannot be overcome without the support of international rescue teams.

4.4.2 Comments

The exercise considers more long-term weather conditions leading to the events of the flood and the description of the scenario begins several months beforehand. The event develops gradually, which is important as the existence of previous incidents of flooding, landslides, rock-falls etc., affects the availability and fatigue of the local national rescue teams when the main event occurs. Another interesting factor is that the highest impact of the disaster occurs a week after the first flood. Such a storyline could also be used in CIPRNet allowing the preceding events to affect the identified critical infrastructures, limiting their capacity or exhausting resources, which could pose an increased impact when the main event occurs. The identified infrastructures in the case of Taranis include damages to transport, energy, healthcare infrastructures, as well as the trade and industry sector.

4.5 Danex 2006

The overall scenario of EU DANEX 2006[33] was mostly based on incidents that actually have occurred and, if they ever should occur simultaneously, would call for the need to activate the European Community Mechanism.

4.5.1 Storyline

According to the scenario a severe storm is raging over the territory of Denmark and southern parts of Sweden. An extremist group, which is part of a global terrorist network, has taken advantage of the chaos caused by the storm, and has detonated several explosive devices causing severe damage on critical infrastructure. It is suspected that dirty bombs and toxic chemical agents have been used.

Initially the capacity of Denmark and Sweden to conduct damage assessments is insufficient, and requests for international assistance are sent to the international community through the MIC making use of CECIS. Immediately hereafter the need for coordination experts as well as intervention teams arises as a result of the national resources being overstretched and a second request is communicated through the MIC.

Following the arrival of international intervention teams and experts, additional explosive devices are detonated causing fire and leaks at a natural gas hub as well as a collapsed railroad tunnel. Almost simultaneously an aircraft is taken into quarantine at the international airport due to suspicion of release of chemical hazardous material substances on board. Furthermore the capacity of the rescue preparedness is stressed to the limits due to a large number of residential fires and harassment in the form of suspicious devices, e.g. handbags containing unknown chemicals and explosives, placed in the vicinity of various fire stations.

As a declared act of sympathy with fellow terrorists in Denmark, another faction of the terrorist network is spreading fear in Sweden after causing a train, carrying liquefied ammonia, to collide with a bus. A chemical warfare agent has been released in a regional co-ordination centre and unconfirmed reports states that a dirty bomb (although small in size) has been detonated in the southern part of Sweden. It is, therefore, decided to redeploy intervention teams from Denmark to Sweden.

[33] EU Danex 2006 Final Evaluation Report:
http://ec.europa.eu/echo/files/policies/prevention_preparedness/eu_danex_2006.pdf

4.5.1.1 Incidents

The exercise is structured in various phases/incidents, which are events related to the exercise, such the arrival of the participants, or events related with the development of the scenario (actual incidents which require team(s) deployment).

The duration of the exercise was six days. Sunday, 17 September 2006, the intervention teams were activated through the MIC. Monday 18 September was dedicated for the first incident (arrival in Denmark) and the welcome dinner. The other incidents - apart from departure - took place Tuesday through Thursday ending with the farewell dinner. Friday 22 September was the day of the Immediate Evaluation Workshop and the last incident (departure from Sweden). The exercise requires the deployment of teams from one affected country to the other, as Sweden also requests for assistance, and teams already operating in Denmark are deployed to Sweden.

The following incidents were exercised:

- Tunnel incident: A terrorist attack has caused a collision between a passenger train and a freight train in a railway tunnel, resulting in a number of injured people in the passenger train. On the freight train an open carriage with barrels containing corrosive materials has been derailed. A number of barrels have fallen off the carriage and lie scattered on the ground leaking. A tanker containing toxic liquid is damaged and is leaking as well. The liquid is slowly evaporating.
- Natural gas incident: A terrorist attack has caused extensive damage on a natural gas processing plant. An explosion forced a building to collapse and severely damaged the gas pipelines. There are a number of injured people - some of which are trapped in the collapsed building.
- Airport incident: A hijacker has forced an airplane to land at Copenhagen Airport, Kastrup. The airplane has been taxied to a remote staging area. The hijacker has an explosive device attached to a toxic substance. During the negotiations the hijacker decides to surrender. As he is descending the staircase from the airplane and is being taken into custody by the police, the explosive device detonates. Passengers in the vicinity of the device are hit by shrapnel and the toxic substance.
- Suspicious handbag incident: A handbag containing several bottles with unknown contents, a battery, some wires and what appears to be explosives is found at the barracks of the regional rescue preparedness centre in the city of Næstved, where OSOCC is located as well. There is a need for determining whether the handbag poses any danger or not.
- Residential fire incident: A residential multi-storey building is on fire. Several persons are believed still to be in the building. The municipal fire brigade has no vacant fire engines and is calling for assistance from the international intervention teams.
- Nuclear incident: At the premises of the Swedish Rescue Services College a dirty bomb has been detonated. A terrorist group is claiming responsibility for the detonation and the subsequent radioactive pollution. This act of terrorism has been carried out to demonstrate their ability to manufacture dirty bombs, and their willingness to use such a device. The task of the intervention teams is to detect, find and mark the places where the radioactive deposits are situated.
- Ammonia incident: A train carrying liquefied ammonia has collided with a small bus, causing a number of injured bus passengers. A tank wagon with ammonia has derailed and is discharging ammonia because of damage to the tank. The municipal rescue services handle the rescue operation, but need assistance to control the discharge of ammonia.

- Chemical warfare agent incident: The Swedish County Administration has established its coordination centre in order to handle the consequences of the storm. Suddenly a number of explosions rock the coordination centre building and it is assumed that it is a terrorist attack using a chemical warfare agent. Special police units guard the building against further explosions, but assistance is needed to establish whether chemical agents have been used or not and to rescue the injured people.

4.5.1.2 Map

The incidents described above are depicted in the following map:

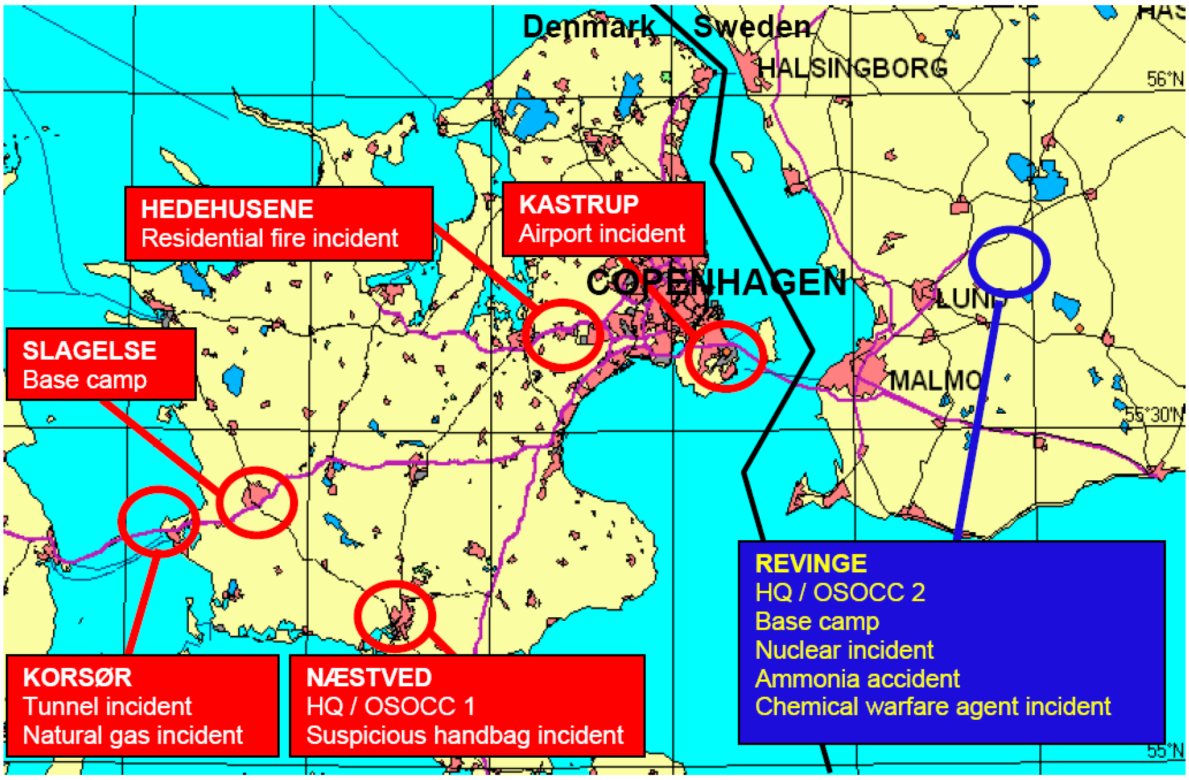


Figure 38: Danex 2006 Exercise Map (Source: EU Danex 2006 Final Evaluation Report)[34]

4.5.2 Comments

The interesting element of this exercise is the consideration that severe weather conditions can be exploited to increase the impact of man-made attacks. The scenarios exercised are treated in combination, as they would be sufficiently handled if they happened in an isolated manner, but they pose challenges if they occur within a limited time frame. This element could be considered in the CIPRNet scenario increasing the effects of the flood scenario by altering the capacity of critical infrastructures, as well as the ability of rescue mechanisms to mitigate them. The scenarios/incidents described above, provide a useful starting point if the CIPRNet team considers adding intentional man-made disruptions in the simulation.

[34] This figure has been retrieved by the EU Danex 2006 Final Evaluation Report of the Danish Emergency Management Agency (November 2006).
http://ec.europa.eu/echo/files/policies/prevention_preparedness/eu_danex_2006.pdf

ANNEX II: GIS DATABASE INFORMATION

Types of data	Source	Country
Flood scenarios in Germany	Landesministerium für Umwelt NRW	Germany
Flood scenarios in NL	Water Boards	The Netherlands
Power grid and details	unknown	Germany
Railway network (power, telco, rail)	unknown	Germany
ZIP Code Classification for NL	CBS GIS data	The Netherlands
Location of hospitals etc	official GIS data (TOP10)	cross-boundary
Mobile telecommunication network	via TNO	The Netherlands
Landline telco network	via TNO	The Netherlands
Mobile telecommunication network	unknown	Germany
Landline telco network	unknown	Germany
Freshwater production and distribution	unknown	cross-boundary
Shipping information river Rhine	unknown	cross-boundary
Traffic light control centre	unknown	cross-boundary
Elevation data (90m)	ASTER	NL + Germany
Power grid BeNeLux (480…50kV)	enipedia TU Delft	BeNeLux
Location of Power Distribution Stations	enipedia TU Delft	BeNeLux
Railway network (rails and their classification)	official GIS data	The Netherlands
Socio-demographic data (district level)	CBS GIS data	The Netherlands
Socio-demographic data (district level)	Geodata Provider	Germany
Road network (different levels)	official GIS data	The Netherlands

ANNEX III: RISICOKAART

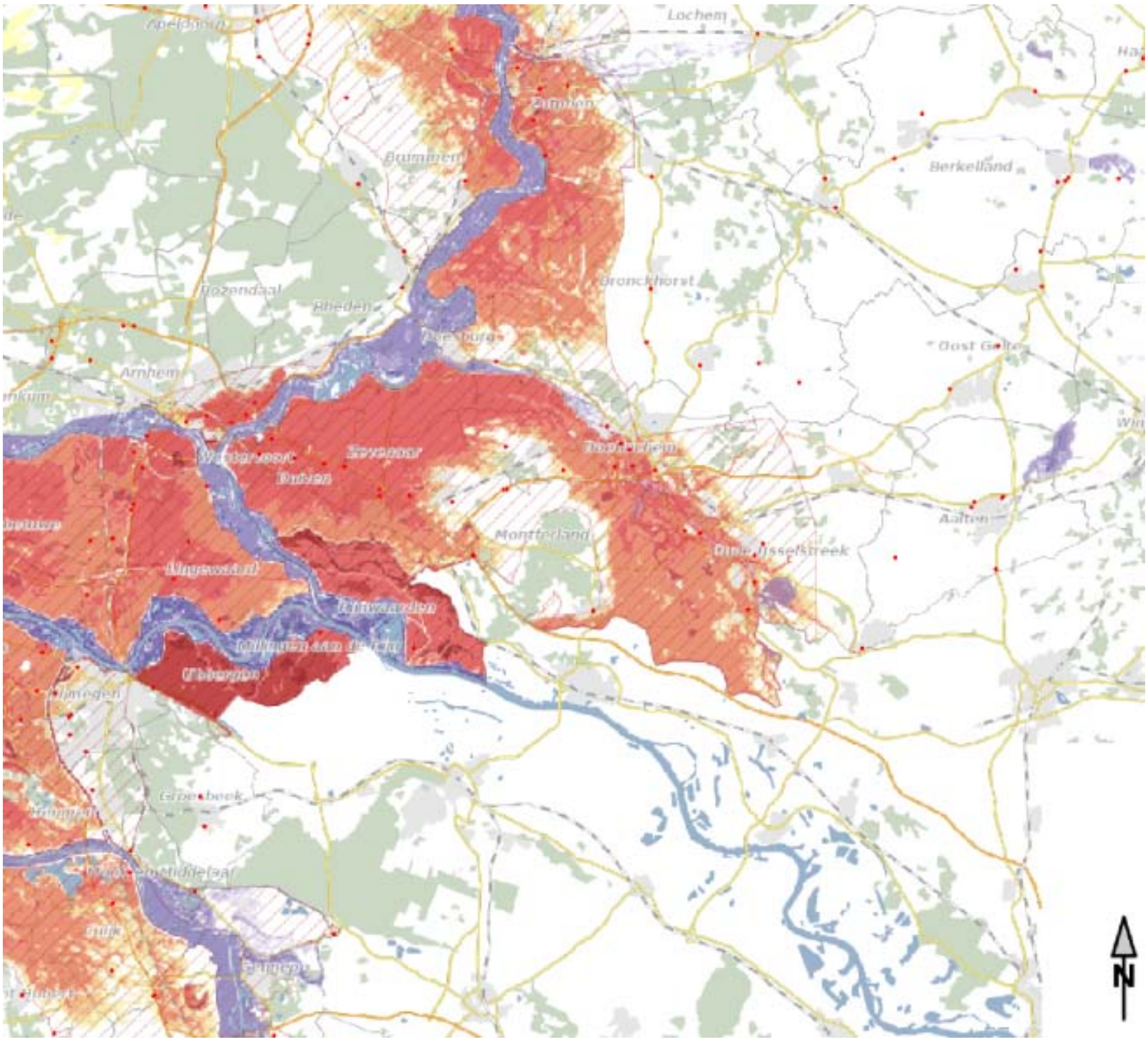


Figure 39: Information on flood hazard derived from the Dutch Risicokaart (source: risicokaart.nl)