RAIN – Risk Analysis of Infrastructure Networks in Response to Extreme Weather

Project Reference: 608166

FP7-SEC-2013-1 Impact of extreme weather on critical infrastructure

Project Duration: 1 May 2014 – 30 April 2017

Security Sensitivity Committee Deliverable Evaluation

Deliverable Reference	**D 7.3**
Deliverable Name	**Pre-standardisation Document & Review of Crisis Coordination and Response Arrangements in the European Union**
Contributing Partners	**GDG & HI**
Date of Submission	**May 2017**

The evaluation is:

- **The content is not related to general project management**
- **The content is not related to general outcomes as dissemination and communication**
- **The content is not related to critical infrastructure vulnerability or sensitivity**
- **Diagram path 1, 2, 3. Therefore, the evaluation is Public.**

Decision of Evaluation	**Public**	**~~Confidential~~**
	~~Restricted~~	

Evaluator Name	**P.L. Prak, MSSM**
Evaluator Signature	**Signed by the chairman of the SSC**
Date of Evaluation	**2017-05-26**

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 608166

This project is funded by the European Union

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Pre-standardisation Document & Review of Crisis Coordination and Response Arrangements in the European Union

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Date: 16/05/2017

Dissemination level: (PU, PP, RE, CO): PU

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 608166

This project is funded by the European Union

DOCUMENT HISTORY

Index	Date	Author(s)	Main modifications
1.0	15th June 2016	Timo Hellenberg, Pekka Visuri	Draft report disseminated for comments
3.0	19th January 2017	Timo Hellenberg, Pekka Visuri	Draft report disseminated for comments
3.1	23rd January 2017	Timo Hellenberg, Pekka Visuri	Submitted for final comments
3.2	12th February 2017	Timo Hellenberg, Pekka Visuri	Comments received and taken into account
3.4	23rd March 2017	Timo Hellenberg, Pekka Visuri	Final draft circulated to WP leaders and RAIN partners
3.5	28th March 2017	Timo Hellenberg, Pekka Visuri	Technical final editing of the final draft
3.7	31st March 2017	Timo Hellenberg, Pekka Visuri	Delivering the final paper to WP leader
3.8	20th April 2017	Timo Hellenberg, Pekka Visuri, Gerry Murphy and Kenneth Gavin	Review and corrections by Gerry Murphy
3.9	10th May 2017	Mark Tucker	Review and comments by Mark Tucker (ROD)
4.0	16th May 2017	Timo Hellenberg and Pekka Visuri	Document finalised by Timo Hellenberg and Pekka Visuri
4.1	16th May 2017	Julie Clarke	Final Editing by Julie Clarke (GDG)

Document Name: Pre-standardisation Document & Review of Crisis Coordination and Response Arrangements in the European Union

Work Package: 7

Task: 7.4

Deliverable: 7.3

Deliverable scheduled date

Responsible Partner: HI

Table of Contents

Executive Summary

The European Union and the associated crisis management mechanisms are increasingly being faced with extreme events that include both man-made and natural crises. Most of the emergency situations that occur nowadays have such wide-ranging impacts and political significance that they require timely policy coordination and response at EU political level. This could result from the number of impacted Member States or the cross-sectoral nature of the crisis, or from a combination of these factors. The need for EU policy and response coordination led to the creation of the EU Emergency and Crisis Coordination Arrangements in 2006, which is currently implemented. The EU Integrated Political Crisis Response (IPCR) arrangements have contributed to improvements in the European Union´s ability to make rapid and efficient decisions when faced with major emergencies, which require response at EU political level. Furthermore, the Integrated Situational Awareness and Analysis (ISAA), developed by the European Commission and the European External Action Service (EEAS), provides the capability to determine the appropriate procedure to be adopted to ensure political coordination and to prepare policy options for Council decision making when facing crisis situations.

This report, entitled "Pre-standardisation Document & Review of Crisis Coordination and Response Arrangements in the European Union", assesses EU crisis coordination and recent decision-making developments, as well as providing recommendations to improve existing EU policies and infrastructure protection guidelines. It describes the full range of EU crisis management instruments that can be used to tackle internal and external crises. As such, it aims to develop holistic hazard response strategies when faced with extreme weather events. The document also provides information about existing policy instruments and examines past case studies at national and international levels. In addition, current procedures for EU critical infrastructure protection, crisis coordination and decision making are examined and recommendations for improvements are outlined. Finally, crisis coordination simulation is outlined for a fictive case whereby a land transport infrastructure network is disrupted due to an extreme weather event in Finland.

This report was completed as part of the EU-funded RAIN Project (Risk Analysis of Infrastructure Networks in Response to Extreme Weather). The policy recommendations outlined herein are based on the expertise of the authors in relation to disaster response within the EU Member States, as well as input from work packages 2, 3 and 6 within the RAIN project. Additionally, the recommendations outlined in this report are also based on input that was gathered from end users, such as rescue services and ministries. The main findings of this report are as follows:

- What is often desired by the end users and first responders, including citizens, is a joint command and control body with four essential characteristics: 1) juridical power, 2) operational capacity, 3) technological advantage, and 4) a political mandate. These are needed to avoid an overly rigid sectoral structure that obstructs horizontal information flow and slows the definition of the character of the actual crisis situation.
- The effective and efficient EU response measures should be formulated based on the coherent and combined situational awareness of the Member States that includes shared and two-way situational data.

- EU policy evolvement in crisis management is dependent on simultaneous success with the coordination at the political-strategic level, facilitated by the EU Integrated Political Crisis Response arrangements (IPCR), and the operational-tactical level action, coordinated by the Emergency Response Coordination Centre (ERCC).
- Although the ERCC serves as the operational coordination hub for EU civil protection and crisis management, the cooperation amongst the Member States has the potential to be enhanced. While it is recognised that civil protection (CP) is a matter of national concern, it should not prevent individual Member States from requesting assistance through the EU's CP mechanism in the case of an emergency that overwhelms national capacities. In order to receive such assistance, the Member States need to develop adequate Host Nation Support structures and procedures; as demonstrated by some Member States already.[1]

[1] A mega disaster where the Solidarity Clause can be activated is an extreme example. However, the mechanism has been activated in other emergencies as well, several times inside the EU. Some examples are major floods and forest fires. Sweden requested assistance for forest fires in Västerås only two years ago, which was provided by Italy and France in the form of amphibious forest fire airplanes.

1. Introduction

The risks that threaten modern societies have become increasingly complex and generally require cross-border cooperation. In response to this, our risk assessment processes, in terms of technology, administration and policy, as well as our levels of risk awareness have evolved over the years. For example, following the series of terrorist attacks that occurred in the United States, London and Madrid in the early 2000s, the vulnerability of infrastructure against terrorism has become a primary concern for authorities. While it is recognised that the risk of infrastructure failure cannot be fully eliminated, the European Union is striving to ensure the protection of critical infrastructure insofar as possible.

In 2005, the tsunami that occurred in the Indian ocean caused devastating losses, and resulted in a shift in thinking regarding civil security for many countries, including those within the European Union. This disastrous event sparked the need for *an integrated approach* to disaster response and crisis management that ensures widespread societal security. Just two weeks following the Asian tsunami, severe flooding occurred in the Nordic and Baltic countries due to a storm surge in the Gulf of Finland. This extreme event challenged the crisis management systems in these regions, in particular the interoperability of their early warning mechanisms, as outlined in Case Study A in this report. Furthermore, when Hurricane Katrina hit the United States in 2007, the US Homeland Security had been focused mainly on counter-terrorism at the time.

Therefore, the need for a multi-hazard approach to civil security and crisis management has emerged in recent years. The main lesson that has arisen from disaster events such as those mentioned, has been the urgent need to develop a new integrated safety and security culture that is prepared to respond to multiple crises. Since then, the concept of **societal resilience** has been introduced in many Member States in an effort to create safer societies and to the safety of citizens.

An important aspect of crisis coordination in the European Union at international, national and regional levels is the ability to handle the various administrative stakeholders and to manage parallel communications in crisis situations. The weather hazards currently affecting Europe have the potential to have a widespread impact on critical infrastructure due to the growing interdependency of societies. Furthermore, extreme weather events, especially those that have cross-border impacts, have the potential to have political repercussions. In general, administrative personnel are not adequately equipped or prepared to effectively response in such crisis situations, which require an abrupt response and multi-sectoral control measures. In such situations, ad-hoc arrangements are commonly adopted, resulted in operational problems. The reason for this is that the management of permanent crisis response organisations is often a challenge for politicians and civil servants. The use of ad-hoc coordination groups, however, presents its own challenges since the special resources and services required in such disaster situations are not provided.

For example, such ad-hoc coordination groups were created in Finland in response to the extreme storm surge event that occurred in 2005, as described in Appendix A, despite the fact that Finland has a comprehensive crisis management system in place. An ad-hoc leadership can create a lot of confusion at operational level since it duplicates the existing national system, resulting in a chaotic situation and uncertainty regarding responsibilities. In contrast, the enhancement of the capabilities

of the permanent disaster response system is preferable. In particular, what is sought is a joint command and control body that has four essential characteristics: 1) juridical power, 2) operational capacity, 3) technological advantage, and 4) a political mandate. This structure has the benefit of good communication across different sectors.

In general, the line between civilian crisis management operations and traditional rescue operations is often very thin. As a general rule, if the political and security crisis situation is more demanding than the usual rescue tasks it should be defined as a civilian crisis management operation. However, governments have been slow to develop an efficient multilateral structure to handle disasters. Although much research has been conducted in relation to civil security administrations and policy-making in the European Union, there has been little research conducted in relation to the EU crisis-management performance for transnational emergencies. Notably, there have been ongoing power struggles between various EU-bodies and Member States that have hindered possibilities for the EU-level crisis management organisation to act effectively as a supreme body for civil security duties.[2]

Nowadays, the **EU security strategy** emphasises the need for critical infrastructure protection (CIP). The aim is to strengthen the resilience of key functions, i.e. vital infrastructures such as border and transport security by reducing their vulnerability. The evolving CIP policy is based on a multi-hazard approach that takes into account both natural and man-made disasters. However, there are a number of initiatives that remain to be implemented by the European Commission to systematise and institutionalise this process. To date, the Member States have adopted a rather passive approach towards the protection of critical infrastructure, which has resulted in an increased demand on policy planning to pave the way for this CIP initiative. The aim of the CIP is to provide a common framework for dealing with issues of security and safety but where the powers and capabilities remain the authority of the Member State. Unfortunately, the Member States often strive to preserve their sovereignty in civil security matters. After all, each Member State is responsible for the protection of their own citizens. However, this should not preclude international cooperation and support to other Member States that are overwhelmed by disasters, as well as mechanisms to receive aid, where required. However, this presents a challenge to the European Union in terms of its ability to cope with the growing need for cross-border crisis management procedures. However, as we are all too aware, it is seldom that catastrophic events, such as extreme weather events, don't have cross-border impacts. As such, there is an urgent need for a comprehensive approach to crisis management within the European Union that brings together the various policies and crisis response procedures currently being adopted in the Member States.

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[2] Hellenberg, Timo and Visuri, Pekka. A comparative study on crisis management systems in Europe. Working paper in the Aleksanteri Institute, University of Helsinki, October 2009.

Hellenberg, Timo and Visuri, Pekka. eds. Securing the Air Traffic, Case CBRN Terrorism. Aleksanteri Institute, University of Helsinki, 2011.

ANVIL was an EU co-funded security research project in FP7. The main goals of ANVIL have been to try to reveal what works and what doesn't work for national and regional civil security systems across Europe, to provide advice to policy makers about this, and to identify emerging research needs for future EU research programmes. Project Anvil. Available: http://anvil-project.net/project/

1.1 Aims and Methodology

The aim of this report is to examine the latest developments of the EU crisis coordination and decision making arrangements, with a particular focus on critical infrastructure protection. To do so, a review of the available EU documents relating to crisis management has been conducted and various interviews have taken place with officials. This research has provided a basis for the recommendations and guidance that have subsequently been presented for the improvement of existing crisis management systems and possible changes to existing policy.

This study is based on multidisciplinary and applied social studies, with a special emphasis on intergovernmental relations. The focus of the study is on the crisis coordination and decision making capabilities of the European Union and its ability to respond to and to manage both natural and man-made disasters. As part of this study, a number of case studies have been examined, as described in Appendices 1 and 2. In addition, a hypothetical extreme weather scenario has been examined to determine the impacts on land transport infrastructure.

1.2 Research Questions

The main research questions addressed in this report are as follows:

- How do the existing EU emergency and crisis coordination procedures function in complex civil crisis situations?
- How do the EU institutions, the affected Member States and presidency interact when faced with a crisis situation?
- How would the existing EU emergency and crisis coordination procedures function if faced with a severe weather event that has the potential disrupt land transportation services?
- Which of the existing EU policies are effective and what aspects of crisis management require further reinforcement through better policies?
- Which of the existing EU policies are poorly structured and what needs to be improved?
- What are the gaps in the existing EU emergency and crisis coordination procedures and what should a new policy specifically address?

1.3 Glossary of Terms and Definitions

Crisis: An unexpected situation where important national values and assets are at stake either domestically or internationally, with time pressure and uncertainty prevailing.

Emergency situation: A situation that can be managed with usual measures without special crisis management arrangements. However, the same system of alarm and decision making should be used as a basis for preparedness and response measures.

Crisis management: The actions taken before (e.g. research, training and planning), during (e.g. decision making, planning, leadership, cooperation and information) and after (e.g. evaluation, learning and encouraging) a crisis situation.

COREPER: Comité des Représentants Permanents: Permanent Representatives Committee (EU ambassadors).

EEAS: European External Action Service.

ERCC: Emergency Response Coordination Centre; part of Commission DG ECHO, acts as 24/7 point of contact to the IPCR.

GSC: General Secretariat of the Council of the European Union.

IPCR: EU Integrated Political Crisis Response arrangements.

IPCR roundtables: Informal meetings chaired by the Presidency to gather information, identify shortcomings, and propose solutions.

ISAA: Integrated Situational Awareness and Analysis.

ISAA inputs: Information on the situation (reports, maps, media monitoring etc.) shared by member states or EU agencies for the purpose of creating ISAA reports.

ISAA lead: The Commission or EEAS service designated as the 'pen-holder' of a ISAA report.

ISAA reports: Integrated situation report developed by the European Commission and the EEAS.

Managing Authority: The authority response for management of the rights/access for its community of users on the IPCR platform.

SC: Solidarity Clause in the EU Lisbon treaty, article 222.

Validating Authority: The authority that holds the right to publish official contributions validated at national or institutional level.

Web Platform Administration: General Secretariat of the Council (GSC). In principle, contacts with the administrator go through the managing authorities.

Resilience: The ability of an individual, a household, a community, a country or a region to prepare for, to withstand, to adapt, and to quickly recover from stresses and shocks without compromising

long-term development prospects. The new approach to building resilience provides an opportunity to bring together political dialogue, humanitarian and development work and priorities in a comprehensive, coherent and effective approach to achieve better results on the ground. Building resilience not only reduces suffering and loss of life but is also more cost effective.[3] The EU Approach to Resilience recognises the need to address the root causes of crises, especially recurrent crises, chronic poverty and vulnerability and to take a long-term perspective which is firmly embedded in local and national policies and linked to complementary action at regional level. The approach incorporates a number of key components including the following: the need to anticipate crises by assessing risks; a greater focus on risk reduction, prevention, mitigation and preparedness; and further efforts to enhance swift response to and recovery from crises. The EU approach to resilience is aimed at addressing both natural and man-made disasters, including slow- or rapid-onset disasters, large-scale emergencies and localized but frequent stresses and shocks, as well as crises in fragile or conflict-affected states.[4]

1.4 Analytical Framework

National crisis management (CM) arrangements should be available for the benefit of citizens, territory, property and interests. In a comparative study of national CM systems in Europe we have used the following “ideal types” or “polar types” as analytical means for description of the structures and functions:[5]

- Centralized - decentralised
- Integrated - specialised
- Institutionalized - ad hoc
- Political (mandate) - professional
- Public - private
- Administrative - technological
- Comprehensive - civil/military
- Information open – segmented
- Progressive – reactive

The national CM systems can be placed on each axis, and they could there be assessed in relation to the opposite ends, for example between the poles “private – public”. A national CM system can be named e.g. “Very centralized, integrated, institutionalized, professional, balanced public and private, emphasizing technology, using a comprehensive CM approach and having a very open information policy”.

[3] Council of the European Union. Council conclusions on EU approach to resilience. 3241st Foreign Affairs Council meeting. Brussels, 28 May 2013. Available: http://www.consilium.europa.eu/uedocs/cms_Data/docs/pressdata/EN/foraff/137319.pdf
[4] Ibid.
[5] Timo Hellenberg and Pekka Visuri, A comparative study on crisis management systems in Europe. Working paper in the Aleksanteri Institute, University of Helsinki, October 2009.

During our earlier studies on crisis management systems we have found the following general trends in the development of national crisis management systems[6] in Europe:[7]

- After the Cold War a clear emphasis on the preparation for the prevention and response to peace-time disasters and terrorism.[8]
- Trend towards an all-hazards principle in CM.[9]
- More centralization and integration of CM leadership and coordination for civil-military cooperation.
- More centralized surveillance and building of the situation picture, but borderlines between the sectors of administration still exist as hindrance.
- In many EU countries the CM systems have been fundamentally modernized during the last years. There is a constant aim to find synergies and to improve the interoperability. However, preserving the sovereignty often hinders these attempts.
- Emerging trend to standardize CM structures and practices, but the process is slow to advance.[10]

Crisis management systems (i.e. preparedness for disasters and other crisis situations which are threatening the state, society or citizens) have often been developed on the basis of national historic experience and applied according to the national characters of each country's political system, changes in threat perceptions and as reaction to the latest experiences in dramatic crisis situations. They are not so much results of theoretical consideration and scientific studies or concluded from the experience of other countries.[11] That is why the CM systems in European countries differ remarkably, and it is difficult to shape standard structures, procedures and communication rules for crisis management duties. The decisions concerning the development of the crisis management are usually made as a compromise derived from practical experience and political processes. Therefore, the systems are often technologically and operationally outdated, too. Many malfunctions observed in the system are often ignored or are covered only by placebo measures in order to prevent additional work or political and bureaucratic struggles.

After the Cold War the differences between internal and external threats have faded, while the strict dichotomy between peace-time and war-time threat scenarios has been smoothed. The

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[6] Pekka Visuri and Timo Hellenberg, Summer storms 2010 and winter storm 2011 in Finland. Case study in the RAIN Project, June 2015.

[7] These conclusions represent our recent country studies on Finland, Estonia, Latvia and Lithuania compiled in the context of the Analysis of Civil Security Systems in Europe (ANVIL) Project. The ANVIL Project aimed to map the variety and similarities in Europe´s regional and civil security structures, practices and cultures and investigate how variety affects the safety of Europe´s citizens. The results gave policy stakeholders a clear overview over civil security architectures and EU-added value to the debate concerning "not one security fits all". Read more at www.anvil-project.net

[8] Christer Pursiainen, Sigrid Hedin and Timo Hellenberg, Civil Protection Systems in the Baltic Sea Region, Towards Integration in Civil Protection Training, Eurobaltic Publications, 2005.

[10] Ibid.

[11] See e.g. FEMA: Comparative Emergency Management Book. Available at: https://training.fema.gov/hiedu/aemrc/booksdownload/compemmgmtbookproject/

preparedness systems in EU countries which were aimed solely at war situations have disappeared, or they have been changed to be used for countering peace-time disasters or other kinds of catastrophes. However, the natural and man-made disasters, on the one hand, and the crisis situations followed from terrorism or other violence, on the other hand, are rather different by nature. The present preparedness systems are more suitable to handle different situations on the same basis, i.e. on the so called “all hazards” principle. This has some practical difficulties, but they can be minimized with good training of the leadership as well as by standardized communications and logistics. It needs, however, further academic studies and exercises.

European crisis management arrangements and civil security systems in general have been developed towards comprehensive and integrated organisations. The arrangements are rather well functioning in usual civil security duties. Still, there are many defaults especially in cooperation between member states and between the EU regions. The personnel of civil security organisations have only limited experience and often limited capacities for working effectively in unexpected and complicated crisis situations, together with their ordinary tasks.[12]

[12] Project Anvil. Available: http://anvil-project.net/project/

2. The EU Policy Evolvement in Crisis Management

The basic principles of **civil protection** are often regarded as framework elements of the European societies. Civil protection as a concept has not been defined in all Member States. It has partial synonyms often at place such as citizen´s safety, civil security, societal resilience or soft security. None of these however fully meets the purpose and mission of civil protection. The weight of civil protection is based on its unbiased values. In the EU context they are named as humanity, neutrality, impartiality and independence. They are well emphasized by the European Union and its Member States. The Member States have committed to them by ratifying the Geneva Conventions of 1949. Humanity has been defined by the EU as immediate intervention, i.e. human suffering must be addressed wherever it is found. Neutrality is defined as a principle where humanitarian aid must not favour any side in an armed conflict or other dispute. Impartiality shows that humanitarian aid must be provided solely on the basis of need. Independence underlines the autonomy of humanitarian objectives from political, economic, military or other objectives.

Humanitarian principles define what humanitarian aid is; delivering life-saving assistance to those in need without any adverse distinction. Although humanitarian aid is distinct from military or civil security operations per se it has been portrayed recently as being part of overall efforts to build up European scale societal resilience and as such been placed along civil protection and wider crisis management measures. Not surprisingly, the actions are carried out by the European Commission's Humanitarian Aid and Civil Protection department (ECHO).[13] The DG ECHO and the DG HOME (the Justice and Home Affairs) are most relevant EU structures from the critical infrastructure point of view.

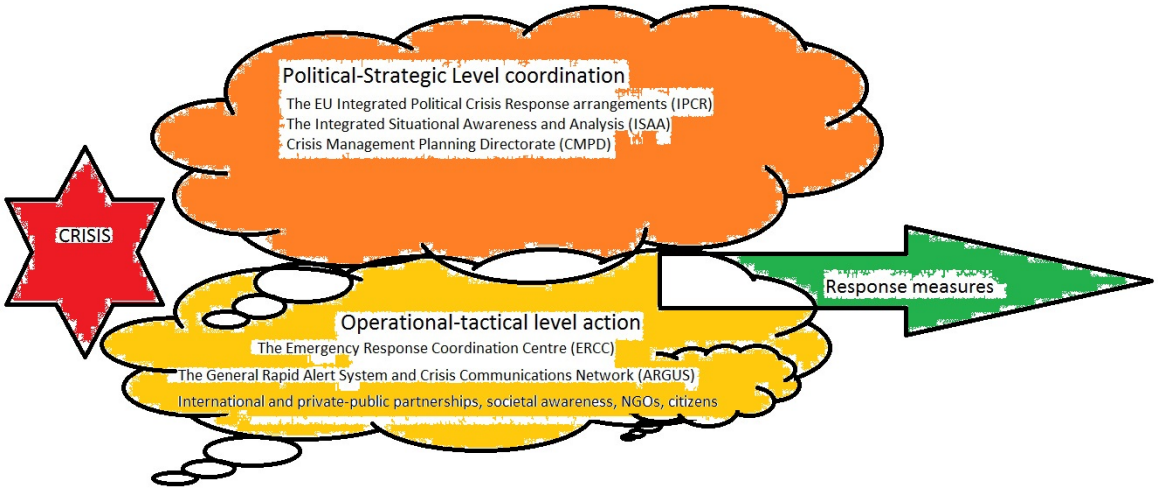

Figure 1: European Union and societal response measures in case of civilian crisis management (Hellenberg International)

[13] European Commission. European Civil Protection and Humanitarian Aid Operations. Humanitarian Principles. 25/01/2016. Available at: http://ec.europa.eu/echo/who/humanitarian-aid-and-civil-protection/humanitarian-principles_en

2.1 Political-Strategic Level Coordination

The first intergovernmental cooperation framework in Europe in the field of crisis coordination was developed by the Trevi Group (Terrorisme, radicalisme et violence internationale) which was already established in 1975 and consisted of the meeting of Ministers of Home Affairs. In 1999, the mentality of looking at internal security matters from a common point of view increased with the Treaty of Amsterdam when the "area of freedom, security and justice" was created. However, it wasn't until the attacks of 9/11 in the USA in 2001, that a culmination point was reached for the EU's approach on more comprehensive crisis management.[14]

European Security Strategy (ESS) was adopted in December 2003 and was the first of its kind. It identified threats facing the EU, defined its strategic objectives and set out the political implications for Europe. The emphasis was on common and concerted action when dealing with the complex problems and interdependence of vital infrastructures.[15] The main challenge was, however, acknowledged also in the ESS, on how to better co-ordinate the external action with the Justice and Home Affairs (JHA) policies. For a wider cooperation, the ESS underlines multilateral cooperation and partnerships.

In the wake of the Madrid bombings, in March 2004, Declaration on Solidarity against terrorism and other threats to the societies[16], i.e. the guideline towards a "solidarity clause" was adopted. This formed the first concrete basis for the enhanced cohesion among the civil security structures and national capabilities in Europe. It also laid the foundation for the upcoming policies of the critical infrastructure protection.

The **Solidarity Clause** is included in the prevailing basic treaty on the European Union, the Treaty of Lisbon 2009.[17] According to the clause, the Union and its member and the acceding states shall act jointly in a spirit of solidarity if one of them were a victim of a terrorist attack or victim of a *natural or man-made disaster*. This approach is now widened to the all-hazards approach when it initially only concerned terrorism.

The solidarity clause imposes a legal obligation on the Union and the member states to act jointly in cases mentioned above. Its implementation, as currently proposed at the EU level, is largely based on bringing together existing tools, structures and capabilities to build and enforce synergies between them. To avoid duplications and improve efficiency, the joint proposal employs a network-based approach with one "centre of gravity", whereby the most pertinent centre will serve as a hub and an interface with member states and will be supported by relevant expertise.

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[14] Jörg Monar Common Threat and Common Response? The European Union's Counter-Terrorism Strategy and its Problems. Government and Opposition, Vol. 42 (2007), No. 3, pp. 292-313.
[15] European Security Strategy 2003. Available at: https://www.consilium.europa.eu/uedocs/cmsUpload/78367.pdf
[16] Declaration 25 March 2004, 7906/04: http://www.consilium.europa.eu/uedocs/cmsupload/79635.pdf
[17] The solidarity clause is included in the Lisbon Treaty. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:12008E222&from=EN

The Solidarity Clause in the Lisbon Treaty stipulates the following:

- The Union and its Member States shall act jointly in a spirit of solidarity if a Member State is the object of a terrorist attack or the victim of a natural or man-made disaster. The Union shall mobilize all the instruments at its disposal, including the military resources made available by the Member States to:
    - Prevent the *terrorist threat* in the territory of the Member States; protect democratic institutions and the civilian population from any terrorist attack; assist a Member State in its territory, at the request of its political authorities, in the event of a terrorist attack;
    - Assist a Member State in its territory, at the request of its political authorities, in the event of a *natural or man-made disaster*.

In March 2008, the Commission in its Communication "Reinforcing the Union´s Disaster Response capacity" (Communication from the Commission to the European Parliament and the Council on Reinforcing the Union's Disaster Response Capacity. Brussels, 5.3.2008. COM (2008) 130 final), put forward practical proposals paving the way for a comprehensive and integrated EU response. The Communication highlighted the urgency for an integrated approach to disasters bringing together prevention, preparedness, response and recovery. It further addressed all kinds of disasters (inside or outside the EU), and it covered for the first time all EU Community instruments as well as inter-agency cooperation. Four key areas were addressed: Increased inter-institutional cooperation, reinforcement of European humanitarian aid, gearing up of European civil protection, improved coordination of disaster response capacities across various Community policies. Since then the Commission has undertaken a number of actions in these areas, such as:

- Defined multifaceted scenarios in various fields of disaster relief operations inside and outside of the EU
- Developed better crisis management tools to enhance the information exchange with and between EU member states
- Developed the Monitoring and Information Centre (MIC) functioning at that time as an operations centre of European civil protection intervention.

Within the area of freedom, security and justice, the EU needed to ensure the balance between civil liberties and a high level of security. In February 2010, the European Council approved an **Internal Security Strategy for the European Union** (5842/2/10). The strategy laid out a European security model, which integrated among others action on law enforcement and judicial cooperation, border management and civil protection. The strategy highlighted the challenges the EU was facing, including natural disasters and other weather hazards. The strategy put weight on prevention and information sharing among member states.[18]

According to Article 67(3) TFEU, one of the EU's objectives is to ensure a high level of security within the common area of freedom, security and justice (FSJA). In order to achieve this objective, the

[18] Council of the European Union: EU Internal Security Strategy, 25.2.2010; 6870/10. Available at: http://register.consilium.europa.eu/doc/srv?l=EN&f=ST%205842%202010%20REV%202

Stockholm Programme (2009-2014) and the European Internal Security Strategy (2010), adopted by the Council, set out plans for legislative, operational and budgetary measures.[19]

However, full implementation of this strategy required other EU institutions – the European Parliament, Commission and the Court of Justice – to fulfil their essential roles. In particular, this applied from December 2014, when the five-year "transitional period" for judicial and police cooperation ended. In the meantime, within the Council the Committee on Operational Cooperation on Internal Security (COSI), established by Article 71 TFEU, had become a regular working tool for Member States and EU agencies.

In 2010, the Commission set out five priorities for putting the ISS into action. The Commission published a second implementation report in April 2013, evaluating progress on each of the five strategic priorities. One of these key strategies is increasing resilience to crises and disaster. A report by the European Council on the development of the internal security strategy was issued in December 2014.[20]

EU resilience to natural or man-made disasters was strengthened through closer member state cooperation in the **disaster-risk management policy framework**, founded on national risk assessments. In 2013, the Commission tabled the first cross-sectoral overview of natural and man-made risks.[21]

In the EU debate at strategic level on European internal security, the Council has not formally involved the European parliament, despite its co-legislator role. Parliament itself took the initiative with a May 2012 resolution on the EU's Internal Security Strategy, which stressed the importance of the values of fundamental rights, the proportionality principle and of the parliamentary dimension in all these policies. The European Parliament has been seeking details of the Commission's plans for the Internal Security Strategy for 2015-19 in various debates.[22]

The **legislative framework** plays a fundamental role in feeding the evolution of the European civil security and infrastructure protection arrangements. It is the most efficient way to encourage implementation of the legislative measures created by the Union for the member states through the provision of multiple incentives. There have been multiple legal developments in the European civil security legislation. For instance, the CP Mechanism was latest amended in 2013, with significant

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[19] Council of the European Union. Development of a renewed European Union Internal Security Strategy. Justice and Home Affairs Council meeting Brussels, 4 December 2014. Available at: https://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/jha/146042.pdf

[20] Development of a renewed European Union Internal Security Strategy, Justice and Home Affairs Council meeting Brussels, 4 December 2014. Available at: https://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/jha/146042.pdf

[21] European Commission, Strengthening Europe's preparedness against natural and man-made disasters. Available at: http://ec.europa.eu/clima/news/articles/news_2013041601_en.htm

[22] See e.g. European Parliament, Implementing the EU internal security strategy, 2013. Available at: https://epthinktank.eu/2013/09/09/implementing-the-eu-internal-security-strategy/

developments.[23] However, the legislation and other official documents such as declarations or action plans only set the premises for actions, they don't implement and solve the problems as such. They all too often only follow the drastic events and sometimes quickly lose focus on each event as media attention shift to other emerging issues.

In order to enable the European Union fully to assume its responsibilities for crisis management, the European Council (Nice, December 2000) decided to establish permanent political and military structures. Presently they build a comprehensive system of institutions.[24]

The civil-military cell includes **permanent political and military structures**. The Political and Security Committee (PSC) keeps track of the international situation and helps to define policies within the **Common Foreign and Security Policy** (CFSP) including the **Common Security and Defence Policy** (CSDP), formerly known as t

he European Security and Defence Policy (ESDP). Formally, CSDP is the domain of the Council of the European Union, which is an intergovernmental body in which the member states are represented. Nonetheless, the **Union High Representative** also plays a significant role. In her position as a Chairman of the external relations configuration of the Council, she prepares and examines decisions to be made before they are brought to the Council. **Political and Security Committee** is an ambassadorial level preparatory body for the Council. Its task is to prepare a coherent EU response to a crisis as well as exercise the EU's political control and strategic direction.

2.1.1 The EU Integrated Political Crisis Response arrangements (IPCR)

In the almost immediate aftermath and as a response to London terrorist bombings in 2005 the JHA Council called for the development of EU Emergency and Crisis Coordination Arrangements "to share information, ensure coordination, and enable collective decision making in an emergency…"[25]. Consequently, on 01 July 2006 the JHA Council approved interim Crisis Coordination Arrangements (CCA).[26] The decision also included the organization of regular exercises in order to test the efficiency and adequacy of the CCA internal procedures.

The EU emergency and crisis coordination arrangements (EU-CCA) defined the rules for interactions between EU institutions and affected EU States during a crisis, while the integrated EU arrangements for crisis management with cross-border effects (EU-ICMA) facilitated practical cooperation between EU States. These provide a generic arrangement for all types of crises, such as natural and man-made disasters.[27]

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[23] Council of the European Union. Decision No 1313/2013/EU of the European Parliament and of the Council of 17 December 2013 on a Union Civil Protection Mechanism. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1401179579415&uri=CELEX:32013D1313

[24] European Union. External Action Service. Available at: https://eeas.europa.eu/topics/common-security-and-defence-policy-csdp/5392/csdp-structure-instruments-and-agencies_en

[25] JHA Council Declaration of 13 July 2005.

[26] Council of European Union, Report and revised Manual on EU emergency and crisis coordination, 20.6.2007. Available at: http://register.consilium.europa.eu/doc/srv?l=EN&f=ST%2010011%202007%20REV%201

[27] European Commission, Migration and Home Affairs. Available at: https://ec.europa.eu/home-affairs/what-we-do_en

The arrangements were cross-pillar and applicable to crises within or/and outside the EU, but not for a crisis affecting individual member states. The London bombings provided the momentum for the work towards the CCA while keeping the focus on the terrorist attacks targeting more than one Member State. Even if terrorism launched the development towards CCA, the aim was not to focus solely on the threat of terrorism but to provide a generic arrangement applicable to all types of crises, e.g. natural disasters, industrial accidents or pandemic flu.

The backbone for the crisis coordination arrangements was the principle of **subsidiarity**. Member States carry the primary responsibility for managing emergencies in their territory and the national competences will be respected. This was particularly important in order to secure the comprehensive participation both by the national and sub-national agencies. No new permanent structures should be established but the existing structures were still used. The arrangements were aimed at enabling the development of a coherent, optimal and pragmatic response to cross-border emergencies by meeting the needs of fast-developing crisis. Despite the generic applicability, tailored solutions should also be possible. However, these have not yet been tested significantly.

The tendency in the EU has been to develop a generic crisis response mechanism emphasising not the threat itself but the protection and resilience of vulnerable targets and the vital functions of these societies themselves. This can be compared with the multi-hazard approach of the critical infrastructure protection (CIP). The comprehensive approach was emphasized also in the CCA which aimed to respond to emergencies affecting more than one Member State directly, simultaneously or by their interests engaged with the responsibilities of EU institutions.

The **Community Mechanism** for civil protection was established by the European Commission in 2001.[28] The Mechanism has been a tool to enhance and facilitate community co-operation in civil protection matters and assistance interventions in and outside of the EU. Even if the mechanism was established in the 9/11 aftermath, terrorism was not mentioned in the 2001 Council decision.[29] A recast of the Council Decision was adopted in 2007.[30]

In terms of overall crisis coordination efforts, the European Union at large now addresses the whole cycle of crisis management actions, i.e. social, technological, and economic.

[28] Council Decision of 23 October 2001 establishing a Community mechanism to facilitate reinforced cooperation in civil protection assistance interventions (2001/792/EC, Euratom).
[29] SN 140/01, Conclusions and Plan of Action of the Extraordinary European Council meeting on 21 September 2001.
[30] Council Decision of 8 November 2007 establishing a Community Civil Protection Mechanism (recast) (2007/779/EC, Euratom). Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32007D0779(01)&from=EN

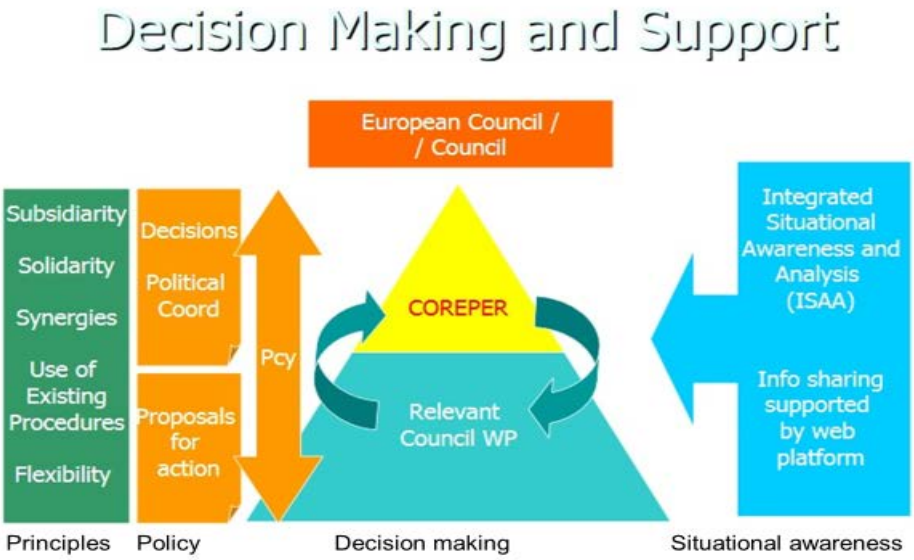

Figure 2: Political coordination and strategic decision making in the EU (Council of the European Union). [25]

The EU framework on crisis management has been significantly strengthened with the adoption of the **EU Integrated Political Crisis Response (IPCR) arrangements** on 25th June 2013. Those arrangements provide a flexible crisis mechanism for supporting the presidency of the Council of the European Union in dealing with major natural or man-made cross-sectoral disasters, as well as acts of terrorism (see Figure 1 and Figure 2) .[31]

The IPCR provides the presidency with several **unique tools** designed to facilitate information sharing, joint decision making, and coordination of the response at the highest political level.[32]

[31] See Agnieszka Nimark and Patryk Pawlak, "Upgrading the Union's response to disasters", European Union Institute for Security Studies, November 2013. Available: http://www.iss.europa.eu/uploads/media/Brief_45_Crisis_response.pdf. See also: Pierre Minard, "The IPCR arrangements: a joined-up approach in crisis response?", European Union Institute for Security Studies, December 2015. Available at: http://www.iss.europa.eu/uploads/media/Brief_38_IPCR.pdf

[32] Council of the European Union. The Eu Integrated Political Crisis Response – IPCR – arrangements in brief, 2016. Available at: http://www.consilium.europa.eu/en/documents-publications/publications/2016/the-eu-integrated-political-crisis-response-ipcr-arrangements/. See also: COUNCIL DECISION of 24 June 2014 on the arrangements for the implementation by the Union of the solidarity clause (2014/415/EU). Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014D0415&from=EN

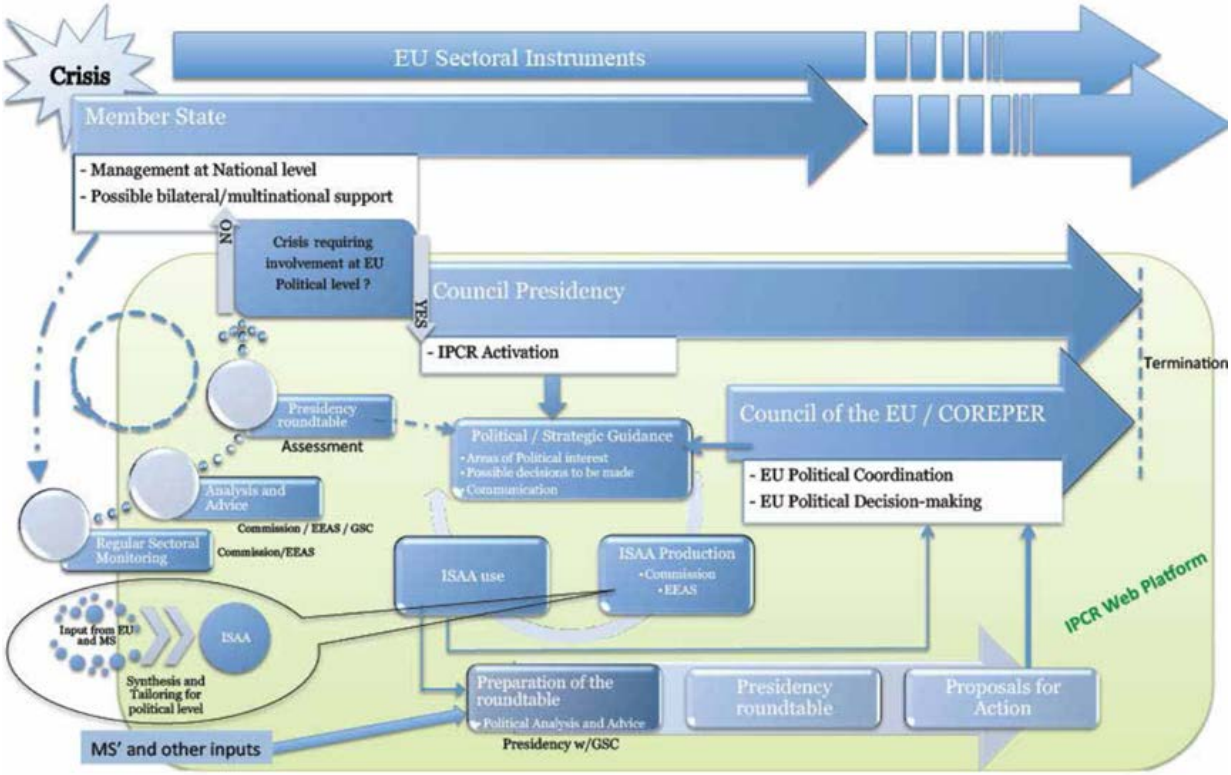

Figure 3: EU Sectoral Instruments and procedures (Council of the European Union, 2013)[33]

An informal roundtable is an informal meeting that allows the presidency to bring key actors and expertise together around the same table, e.g. the European Commission, the European External Action Service (EEAS), relevant agencies, the Cabinet of the President of the European Council and experts from the member states most directly affected or from relevant international organisations. The round table's main function is to support the presidency in the handling of the situation within the Council.

The Integrated Situational Awareness and Analysis (ISAA) report. This is an analytical report, drafted by the Commission and the EEAS, under an ISAA lead service determined by both the Commission and the EEAS depending on the nature of the crisis. Its aim is to provide decision makers with a clear common picture of the current situation.

The IPCR web platform is an online tool that allows the exchange of information, including the ISAA report, situational maps and stakeholders' contributions. It also facilitates the gathering of information for the ISAA reports through questionnaires.

The central IPCR 24/7 contact point, established within the Emergency Response Coordination Centre (ERCC) at the Commission, ensures liaison with key actors, as well as performing monitoring and alerting functions for IPCR purposes. It supports the production and circulation of the ISAA report.

[33] Council of the European Union. Finalization of the CCA review process: the EU Integrated Political Crisis Response (IPCR) arrangements. 7.6.2013, 10708/13, 10. Available at: http://data.consilium.europa.eu/doc/document/ST-10708-2013-INIT/en/pdf

The IPCR can be activated by the presidency in case of a major crisis where there is a perceived need for political coordination between EU member states, regardless of whether the event occurs inside or outside of the EU. It may also be activated following a request from a member state. The level of activation of the IPCR can be fine-tuned to the situation. Three levels are available: a monitoring mode, which does not constitute activating the IPCR, and two levels of activation for which the supporting tools are available, namely information-sharing mode and IPCR full activation.

Monitoring allows information about a crisis to be shared on a voluntary basis, without activating the IPCR. Monitoring pages on the IPCR web platform have covered crises ranging from Syria/Iraq to the Nepal earthquake, and Ebola. This mode does not trigger the production of ISAA reports.

Information-sharing mode involves an obligation for the Commission and the EEAS to produce ISAA reports. A dedicated crisis page is generated by the General Secretariat of the Council (GSC) on the IPCR web platform. Information-sharing mode can be triggered by the presidency or by the GSC, the Commission and the EEAS in line with the presidency.

IPCR full activation, requested by the presidency or the member states, brings higher visibility to the EU response and facilitates the handling of the crisis at EU level through the organisation of (extraordinary) Council or European Council meetings. In addition, full activation entails the preparation of proposals for action with regard to the EU response, prepared at the presidency-led roundtables and presented to COREPER and the Council.

Solidarity Clause. The IPCR also underpins the political response to the invocation of the solidarity clause (Article 222 of the TFEU, which stipulates that the EU and its member states should act jointly in a spirit of solidarity if a member state is the object of a terrorist attack or the victim of a natural or man-made disaster). Invocation of the solidarity clause by a member state automatically triggers the activation of the IPCR.

The Integrated Political Crisis Response arrangements (IPCR) have improved the EU´s ability to take rapid decisions when facing major emergencies which require a political level EU response. On 30 October 2015, the Luxembourg Presidency decided to activate for the very first time the IPCR arrangements in information sharing mode for the refugee and migration crisis. Ten days later, the activation was stepped up to 'full'. Since then, the Presidency has organised numerous IPCR roundtables, usually centred around a particular theme. Topics have included hotspots, the humanitarian situation, internal border controls, the situation on the Western Balkans and Central Mediterranean routes and for instance the implementation of the EU-Turkey statement. There have been IPCR roundtables at expert level and representatives of some affected member states, at the level of ambassadors, and even on some occasions at ministerial level (Justice and Home Affairs, Foreign Affairs). EU agencies, international organisations and NGO's have been invited. For monitoring of migration flows and support to refugees in Turkey, the Presidency also makes use of the IPCR and ensures reporting to COREPER, as well as information to the JHA counsellors.[34]

[34] Council of the European Union. The IPCR activation in numbers, 2016. See e.g.: file:///C:/Users/Käyttäjä/Downloads/web_IPCR%20(2).pdf. For an activation example, see: http://statewatch.org/news/2016/jun/eu-med-crisis-council-docs-11-6-16.htm

In the event of a volcanic ash cloud crisis similar to that which occurred in 2010, the IPCR arrangements would now also permit member states to quickly coordinate their decisions on closing national airspaces, resulting de facto in grounding airplanes across the EU. The arrangements provide a platform for political coordination in the EU, including member states and relevant European bodies and agencies, in a cross-sectoral manner (i.e. between member states, the Council Secretariat General, the Commission, the EEAS and relevant EU agencies) in order to allow a timely, coherent and effective political response.[35]

Especially for large scale emergency and crisis situations the IPCR give EU leadership and member states useful tools which can also be available according to the principles of EU solidarity clause (article 222). In summary, it offers an effective information sharing system and flexible framework for decision making in all kind of situations.[36]

2.1.2 The Integrated Situational Awareness and Analysis (ISAA)

To support preparatory work in the roundtable and inform deliberations in the respective Council meetings, the Commission and the EEAS have developed a procedure of **Integrated Situational Awareness and Analysis (ISAA)**. The ISSA support capability is illustrated in Figure 3. It is a key support capability under the IPCR arrangements as it feeds into the political process by providing factual and integrated situational information. The Platform can be also used in “normal” times to help develop relations between stakeholders and a sort of “IPCR culture” based on information-sharing.

The ISAA support capability will contribute to inform discussions at the roundtable, and later in the COREPER / Council meetings. The overall process is supported by a dedicated Web Platform that facilitates a timely exchange of information.

[35] European Council, 2016. EU Integrated Political Crisis Response (IPCR). Available at: http://www.consilium.europa.eu/en/press/press-releases/2015/10/30-migratory-crisis-activating-ipcr/
[36] Interview of Pekka Tiainen, Ministry of the Interior of Finland. Helsinki 7.3.2017.

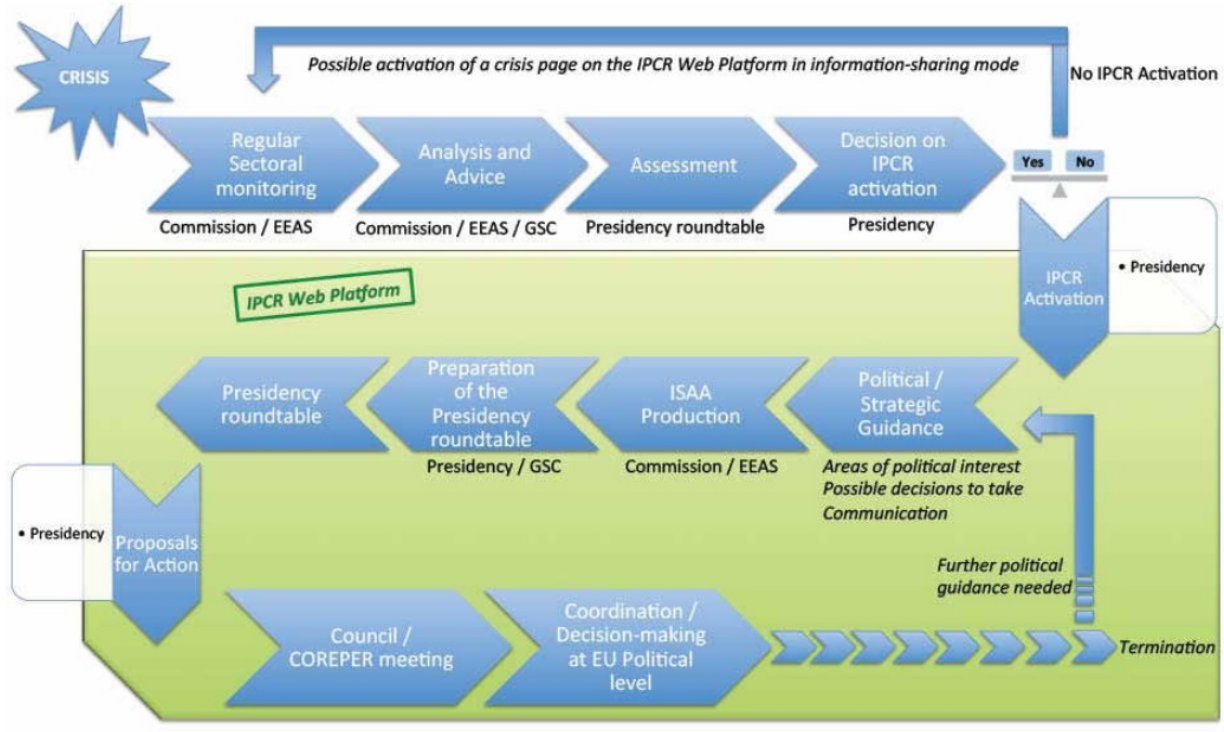

Figure 4: Integrated Situational Awareness and Analysis (ISAA) support capability for decision making in a crisis.[37]

On top of that, the current EU toolbox address crises which may affect the Union's security and interests but occur outside the EU has been further institutionalized with the creation of the **EEAS Crisis Response System**, comprising the Crisis Platform, EU Situation Room and Crisis Management Board.

If the member state cannot deal with the crisis situation without external help, an estimation of the need of help and of political EU-coordination is performed as described above. If political EU-coordination is not needed, the Commission can coordinate EU-operation and member states themselves act together by using the Crisis coordination handbook.

2.1.3 Crisis Management Planning Directorate (CMPD)

In December 2008, the European Council agreed to merge civilian and military aspects of the planning for European peace keeping missions into a single **Crisis Management Planning Directorate** (CMPD)[38]. It was a logical step that would help the EU to be more efficient in its response to conflicts. The military aspect has been given vastly disproportionate weight. One of the problems is to have enough well trained and experienced civilian officials for planning and conduct crisis management duties. According to the Lisbon Treaty (2009) some new structures and arrangements

[37] Council of the European Union. Finalisation of the CCA review process: the EU Integrated Political Crisis Response (IPCR) arrangements. 7.6.2013, 10708/13, 10. Available at: http://data.consilium.europa.eu/doc/document/ST-10708-2013-INIT/en/pdf

[38] European Union. External Action. CSDP structure, instruments, and agencies 08/07/2016. Available at: http://eeas.europa.eu/csdp/structures-instruments-agencies/cmpd/index_en.htm

were beginning to be used for crisis management, but the integration of external and internal administration for crisis management duties has been difficult.[39]

The Crisis Management Planning Directorate is part of the **European External Action Service** which embodies a basic part of the EU Common Foreign and Security Policy (CSDP).[40] The CMPD works under the political control and strategic direction of the Political and Security Committee (PSC) consisting of the representatives of all the 28 Member States. The CMPD also provides assistance and advice to the High Representative and the relevant EU Council bodies. The objective of the strategic planning is to develop possible options for EU action. It also serves as a basis for the decision of the EU Council on "what to do, why, where and with whom" in an international crisis situation. These options are put together in a so-called Crisis Management Concept (CMC) which is proposed to EU ministers for approval. It forms the basis of the operational planning and the conduct of a mission.[41]

The departments assisting in common security and defence policy and crisis response are illustrated in Figure 4.

The Civilian Planning and Conduct Capability (CPCC) has a mandate to plan and conduct civilian Common Security and Defence Policy (CSDP) operations under the political control and strategic direction of the Political and Security Committee (see Figure 4). CPCC works in close cooperation with the European Commission. The CPCC Director, as EU Civilian Operations Commander, exercises command and control at strategic level for the planning and conduct of all civilian crisis management operations, under the political control and strategic direction of the Political and Security Committee (PSC) and the overall authority of the Secretary-General/High Representative for the CFSP (SG/HR).[42]

There have been initiatives and plans to unite the efforts of military (DG8) and civilian (DG9) sectors towards common goals and working with an integrated planning and command structure like the Civilian Planning and Conduct Capability (CPCC). Actually, it is not such a new arrangement because many EU crisis management operations have already had an integrated command structure.[43]

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[39] Isabelle Ioannides, EU Civilian Capabilities and Cooperation with the Military Sector. Available: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1812943 and Alain Délétroz, The spoils of EU reform, Reuters 19. February 2010. Available: https://www.crisisgroup.org/europe-central-asia/spoils-eu-reform .

[40] European Union External Action Service, organization chart. Available: http://eeas.europa.eu/background/docs/organisation_en.pdf

[41] European Union External Action Service. Available: http://eeas.europa.eu/csdp/structures-instruments-agencies/cmpd/index_en.htm .

[42] See: https://eeas.europa.eu/topics/common-security-and-defence-policy-csdp/5438_en and http://www.consilium.europa.eu/uedocs/cmsUpload/100217%20Factsheet%20-%20CPCC%20-%20version%201_EN%20-%20DRAFT.pdf

[43] See Stephanie Blair, “Towards Integration? Unifying Military and Civilian ESDP Operations”, European Security Review 44, ISIS Europe, May 2009.

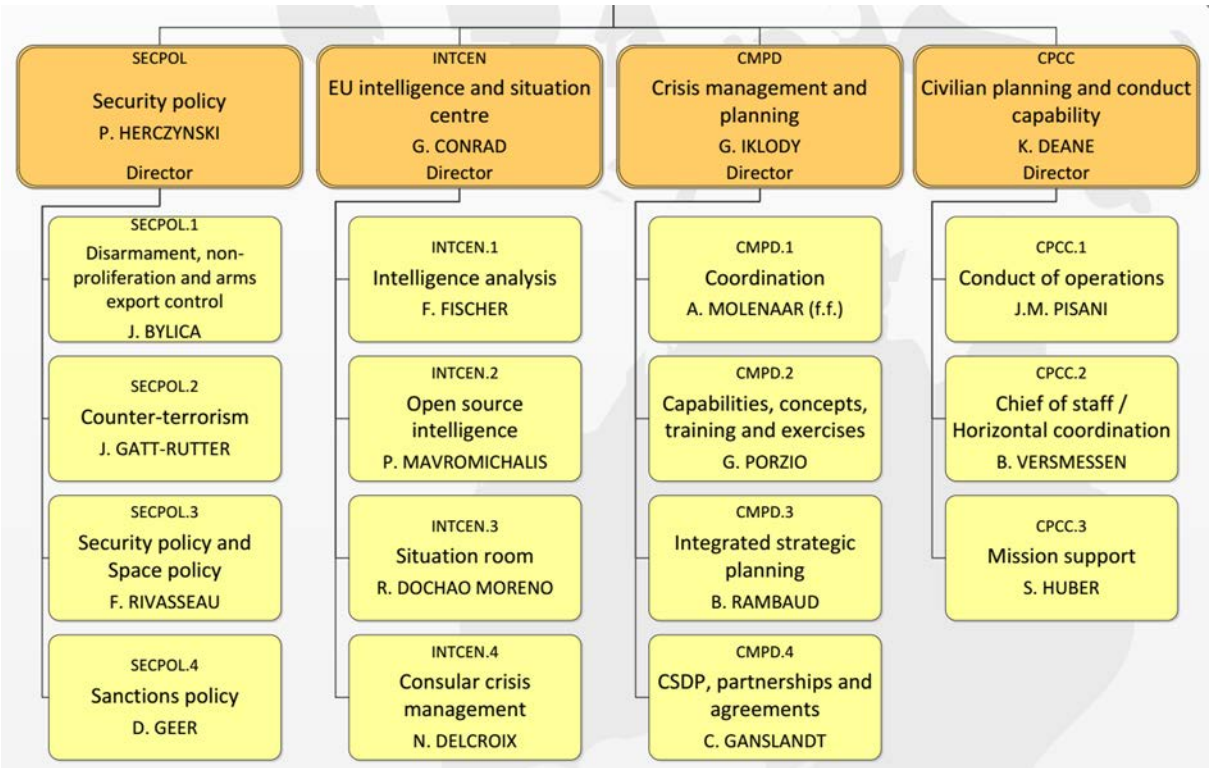

Figure 5: Departments assisting in common security and defence policy and crisis response.[44]

The **Civil Protection Mechanism (CPM) and related Civil Protection Financial Instrument (CPFI)** have also faced review and streamlining towards better integrated approach to crisis and disaster management, equally required by the Lisbon Treaty.[45] The structures of Civil Protection Mechanism currently includes all 28 EU Member States in addition to Iceland, Montenegro, Norway, Serbia, the former Yugoslav Republic of Macedonia and Turkey. The Mechanism was set up to enable coordinated assistance from the participating states to victims of natural and man-made disasters in Europe and elsewhere.[46] Table 1 presents a list of major disasters which resulted in EU Emergency Responses.

Table 1 Major disasters and EU Emergency Response (Agnieszka Nimark and Patryk Pawlak).[47]

CPM activation (upon request for assistance)	
2004/2005	Tsunami in South Asia
2005	Hurricanes Katrina and Rita (US)
2008	Terrorist attack in Mumbai
2009	Severe respiratory infection (H1N1): Bulgaria, Ukraine
2010	Gulf of Mexico oil spill (US)
	Floods in Montenegro, Bosnia and Herzegovina, Albania

[44] European Union External Action Service, 2016. Available: http://eeas.europa.eu/background/docs/organisation_en.pdf
[45] Agnieszka Nimark and Patryk Pawlak. Upgrading the Union's response to disasters. Brief Issue. 45/2013. Available: http://www.iss.europa.eu/uploads/media/Brief_45_Crisis_response.pdf
[46] http://ec.europa.eu/echo/what/civil-protection/mechanism_en .
[47] Agnieszka Nimark and Patryk Pawlak. Upgrading the Union's response to disasters. Brief Issue. 45/2013. Available: http://www.iss.europa.eu/uploads/media/Brief_45_Crisis_response.pdf

	Haiti earthquake
2011	Civil unrest in Libya
	Tunisia (Libya conflict): repatriation of third-country nationals (TCNs)
	Explosion at a power plant in Cyprus
2012	Floods in Austria, Bulgaria, Germany, Czech Republic, Hungary, Romania and Slovak Republic
	Syrian refugees in Bulgaria
2013	Cyclone Haruna in Madagascar
	Syrian refugees in Lebanon
	Syrian refugees in Bulgaria
	Typhoon Haiyan in the Philippines
CCA webpage activation (information-sharing mode)	
2008	Terrorist attack in Mumbai
2010	Earthquake in Haiti
	Eruption of the volcano Eyjafjallajökull in Iceland and related ash cloud problems

There is still need for the enhancement of preparedness in the Union Civil Protection Mechanism. The focus should be placed on developing a coherent planning and management framework for response operations, especially on enhancing the overall level of preparedness for large-scale disasters. Such a framework will require inter alia preparation of reference scenarios, mapping of existing capacities, and development of contingency plans for their deployment. These actions should be combined with the creation of a training network and diversification of the training programmes enacted so far.

The **Internal Security Fund (ISF)** is a financial instrument in the field of civil security and supports the implementation of the EU Internal Security Strategy. It finances operations and projects in law enforcement and supports the management of the EU's external borders. The Fund has two components: "one deals with external borders and visa issues, while the other focuses on police cooperation, preventing and combatting crime, and on crisis management"**.** The renewed EU Internal Security Strategy for 2015-2020 provides a political-strategic framework, supported by the ISF.[48]

2.2 Operational-tactical level action

A number of processes and reforms have been realized at the operational-tactical level since 2012 and 2013 with the aim of strengthening the EU´s capacity to manage and respond to large scale crises and disasters. They imply a reshuffling of responsibilities within and between the institutions in Brussels. Emphasis is placed on the enhancement of intervention and response capabilities, "a qualitative shift from information sharing and reacting to emergencies to a more proactive role of planning, monitoring, preparing, operational coordination and logistical support".[49]

[48] European Commission. Annual Activity Report, 2014. Available: http://ec.europa.eu/atwork/synthesis/aar/doc/home_aar_2014.pdf

[49] Brussels, 26.10.2010 COM (2010) 600 final. Available: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52010DC0600&from=EN .

In its communication on March 23 2013 the Commission commented on the three objectives and on how individual priority areas and actions fit into the revised strategy.[50] These alterations have had consequences for follow-up work on various priority areas.

2.2.1 The Emergency Response Coordination Centre (ERCC)

The transformation of the former Monitoring and Information Centre (MIC) into the **Emergency Response Coordination Centre (ERCC)** has further enhanced the operational and tactical level of EU mechanisms. The Emergency Response Coordination Centre, compared to its predecessor, is an enhanced coordination platform.[51]

The Emergency Response Coordination Centre, operating **within the European Commission's Humanitarian Aid and Civil Protection department (ECHO)**, was set up to support a coordinated and quicker response to disasters both inside and outside Europe using resources from the countries participating in the EU Civil Protection Mechanism. With a capacity to deal with several simultaneous emergencies in different time zones, around-the-clock, the ERCC is a coordination hub facilitating a coherent European response during emergencies helping to cut unnecessary and expensive duplication of efforts. It collects and analyses real-time information on disasters, monitors hazards, prepares plans for the deployment of experts, teams and equipment, and works with Member States to map available assets and coordinate the EU's disaster response efforts by matching offers of assistance to the needs of the disaster-stricken country. Better planning and the preparation of a set of typical disaster scenarios will further enhance the ERCC's capacity for rapid response. The ERCC also supports a wide range of prevention and preparedness activities, from awareness-raising to field exercises simulating emergency response.

Unlike the MIC, the ERCC has a 24/7 monitoring capacity that allows instant reactivity to emergencies. With three separate operational rooms, the Centre has the capacity to manage more than one emergency at the same time. It also provides channels for real-time coordination and information-sharing through videoconferencing, allowing the centre to connect relevant member state authorities (such as national crisis centres), Commission services and Council bodies.

The ERCC does not only perform monitoring and information-sharing tasks but also contributes to the development of emergency response capacities by coordinating the availability and deployment of pools of voluntary pre-identified resources; complementary EU-funded capacities could also be developed to ensure cost-efficiency. The ERCC is also proposed as a single 'entry point' – at operational level – for the possible activation of the solidarity clause, with a view to simplifying procedures.

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[50] Brussels, 23.3.2012 COM (2012) 128 final. Available: http://ec.europa.eu/regional_policy/sources/docoffic/official/communic/baltic/com_baltic_2012_en.pdf

[51] European Commission, Humanitarian Aid and Civil Protection, 2016. Available: http://ec.europa.eu/echo/what/civil-protection/emergency-response-coordination-centre-ercc_en

2.2.2 The General Rapid Alert System and Crisis Communications Network (ARGUS)

The General Rapid Alert System and Crisis Communications Network (ARGUS) was introduced in December 2005 after both natural (tsunami Dec 2004) and man-made (Madrid 2004, London 2005) disasters had taken place.[52] The aim was to answer the need to improve the coordinated management of multi-sectoral crises at the Community level. In the event of an emergency, the Commission may be called upon to support the member states by acting in its domains of competence and by providing comprehensive information to the public and the media.[53]

In the event of a multi-sectoral crisis of natural or man-made origin, ARGUS aims to provide the following elements: information exchange via internal platform in real time, internal coordination, consolidation of the alert systems and having the appropriate processes for decision making ready.[54] ARGUS is based on the principle of subsidiarity and complementarity taking into account the existing Rapid Alert Systems (RAS) and linking it to the Directorate-General's and Commission's services. ARGUS also uses the already existing resources, technology and infrastructure.

In the event of a major emergency it is up to the Presidency to decide, after having been alerted or at the request of a Member of the Commission, to activate the ARGUS coordination process. The President may keep the responsibility for himself or delegate and assign it to a Member of the Commission. The responsibility consists of leading and coordinating the response to the crisis at hand. In addition to the selected crisis-mode instruments and bodies presented here, there exist also EU bodies that operate mainly on the prevention, protection and pursuit areas of the counter-terrorism strategy. These are operational before the crisis occurs, since at the moment of a terrorist strike, they can be said to have failed. These bodies can also be listed under the so called early-warning mechanisms since they deal with risk assessment, investigation and monitoring. In the following some of these relevant bodies are presented shortly.

It is an internal network. Member States and external bodies are connected through sector-specific rapid alert systems. The system:

- Allows each director general in the Commission to inform other director generals and services, of a beginning, or risk of multi-sectoral, crisis via an alert exchange.
- Provides a coordination process that can be activated in case of crisis.
- Provides a common source of information that will be used by the Commission to communicate in an effective and coherent way with citizens. Responsibility for handling and coordinating the response to the crisis including communication aspects should be taken by the relevant director general, under the responsibility of the relevant Commissioner whose

[52] COM (2005) 662 final, Commission provisions on "ARGUS" general rapid alert system. Available: http://ec.europa.eu/transparency/regdoc/rep/1/2005/EN/1-2005-662-EN-F1-1.Pdf . See also: https://ec.europa.eu/health/preparedness_response/generic_preparedness/planning/argus_en .
[53] Creation of ARGUS was mentioned already in the Commission communication on preparedness and consequence management in the fight against terrorism (2004) COM(2004) 701 final.
[54] CIWIN Critical Infrastructure warning information network aims to do the same in the field of critical infrastructure protection, COM (2006) 786 final. Available: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52008PC0676&from=EN .

scope of activities usually includes this type of crisis because of its nature. The coordination with other directors general is made via the Argus network.[55]

In short, ARGUS is relevant as the Commission's own crisis coordination and communication mechanism, with some coordination tasks delegated to the ERCC.

2.3 Other Crisis Management associated functions

Critical Infrastructure Warning Information Network (CIWIN) has been developed as a Commission owned protected public internet based information and communication system, offering recognised members of the EU's CIP community the opportunity to exchange and discuss CIP-related information, studies and/or good practices across all EU Member States and in all relevant sectors of economic activity. The CIWIN portal, following its prototype and pilot phases, has been up and running since mid-January 2013. DG HOME coordinates all activities relating to CIWIN and nominates the content manager of CIWIN. DG HOME consults the representatives of Member States – the CIP Points of Contact – on strategic issues related to CIWIN. The CIP Point of Contact of the Member State nominates a CIWIN Executive and Support Officer who provide assistance to the European Commission in the context of the use and development of the CIWIN system.[56]

The European Union's Judicial Cooperation Unit (Eurojust)[57] celebrated its tenth anniversary on 28 February 2012. The discussion on the establishment of a judicial cooperation unit was first introduced at a European Council Meeting in Tampere, Finland, on 15 and 16 October 1999, attended by heads of state and government. This meeting was dedicated to the creation of an area of freedom, security and justice in the European Union, based on solidarity and on the reinforcement of the fight against trans-border crime by consolidating cooperation among authorities.[58] The Eurojust is a central agency in developing the legal framework for supporting the CIP implementation. In the EU framework there are many functions which can strengthen efficiency of civil protection measures but also some tendencies which can reduce it. Table 2 compares some controversial aspects in this respect. They should be observed and the problems must be solved.

Table 2 EU framework functions capable of strengthening or reducing the efficiency of civil protection measures

Strengthening EU's added value	Undermining EU's added value
Coordination, cooperation, teambuilding	Bilateral and multilateral agreements on assistance and support
Collective capability and policy synchrony	Strengthening national capabilities on domestic safety and security
International and private-public partnerships	National responses to international threats and overlapping capacities e.g. training
All-hazards approach	Counter-terrorism and natural disasters cannot be

[55] European Commission. 2016. Public Health. Available: http://ec.europa.eu/health/preparedness_response/generic_preparedness/planning/argus_en.htm
[56] European Commission, Migration and Home Affairs. 2016. Available: http://ec.europa.eu/dgs/home-affairs/what-we-do/networks/critical_infrastructure_warning_information_network/index_en.htm
[57] Eurojust. 2017. Available: http://eurojust.europa.eu/
[58] European Commission (2016). EUROJUST. Available: http://www.eurojust.europa.eu/about/background/Pages/history.aspx

	solved in one-size fits all approach
Solidarity	Preserving sovereignty

3. How can current EU policies and infrastructure protection guidelines be improved?

In the European Union, the member states have rather different expositions to risks and threats of civil security. There are some countries threatened by man-made disasters, and countries which are especially exposed to natural catastrophes. For example, the primary concern for the country of Finland is a severe weather situation, especially winter storms, flooding in shore areas and cold, combined with their potential to disrupt the electric power grid. Such a situation can also affect communications, and at worst, endanger the safety of nuclear power plants and requires clear and efficient policy to reduce the negative consequences of the event.

European integration forms a unique ensemble of people, ideas, technology and goods moving freely within the European Union. Many borders have been broken down to promote the openness, democracy and solidarity. However, almost as much of control, supervision and joint monitoring is being increased due to fear that some people are abusing these cherished freedoms. It is seen as indispensable for the EU to enforce its critical infrastructure protection activities but at the same time guaranteeing the basic civil rights and freedoms of its citizens.

What is often desired by the interviewed civil security end users and first responders is a comprehensive crisis management and disaster response system which can handle all kinds of situations, whether they are epidemics, environmental disasters or complex man-made emergencies. There could be on all levels a single authority that can use different instruments simultaneously.

Almost all of these instruments, legislative or operational, demonstrate and reflect the level of cooperation, integration and confidence that exists between member states in order to counter terrorism and other threats to civil security ever more efficiently. However, for knowledge about the actual effectiveness, adequacy and possible gaps of these instruments more research and practical exercises must be done, and their results should be assessed by political decision-makers. It has too often happened in practice that one only gets answers post-factum, after a crisis has already occurred. Instead, the aim is to ask relevant questions and get the answers before something critical and threatening happens. The bodies, mechanisms and instruments should be tested beforehand.

In Europe, generally well-functioning systems for prevention and mitigation of natural and man-made disasters have been created for a specific geographical and functional area, e.g. fire-fighting in the Finnish conditions. Attention has usually been paid to known circumstances that can cause a disaster and could incapacitate the prevention and response systems. Overwhelming leadership challenges can emerge if a crisis or other special situation takes place with multifaceted implications and cumulating interruptions on the technical and societal infrastructures.

It is important for the development of the organisation of emergency administration and disaster management to shape threat scenarios which include surprising elements as well as very complex and dangerous situations with potential for catastrophe. They should be possible but not necessarily very probable. The purpose of “worst-case scenarios” is to identify and localize the “breaking

points", to enhance understanding of the nature of severe crises, and to find out where the preventive measures can fail or are missing.

Both national and regional civil protection arrangements should be planned to cope with all kind of crises and emergencies. They can be tested with worst-case scenarios, where they should function well also in very severe situations with elements of surprise and potential for developing into large-scale disasters.

Rescue services and other civil security administrations in European Union face multiple challenges, as man-made and natural disasters are increasing and becoming more complex than before. There are good reasons to emphasise the regional EU approach as far as response strategies to natural catastrophes are concerned. For example, the making of EU strategy for the critical infrastructure protection in the Baltic Sea region could have following guidelines:

- Civil protection in a macro-regional and cross-border context, from an all-hazards perspective, includes prevention, preparedness, response and restoration;
- Focuses on emergencies and hazards both on land and at sea.

A most important duty for all levels of emergency and disaster administrations is good situational awareness and effective management of news media. Good situational awareness is the basis for both operational rescue measures as well as for safeguarding the functions of society. It is also a precondition for the governmental and local news service which is needed for relevant and correct crisis information.

The three case studies studied for this report as described in the Appendices (flooding of 2005, summer storm of 2010 and winter storms of 2011) have indicated several administrative, technical and policy aspects which should be improved in order to enhance the general resilience of the European Union, and especially the resilience of the land transport infrastructure against natural risks.[59]

3.1 Political-Strategic Level Recommendations

Political-strategic level conclusions derived from the case studies in this report are as follows:

1. Crisis management requires national civil security officials to run effective *inter-operable* communications both internally and externally.
2. Internally, the situational picture should be built among shareholders and shared. Both chief rescue officials interviewed for this RAIN study paper mentioned shared situational awareness to be the main goal of future developments.

59 See Ministry of the Interior press release 29.12.2011. Available: http://www.intermin.fi/fi/ajankohtaista/uutiset/uutisarkisto/1/0/sisaministerio_analysoi_pelastustoiminnan_ja_hatakeskustoiminnan_sujuvuuden_myrskytilanteessa_29274; See also Report of Ministry of the Interior, 14.3.2012, pp. 7–9. Available at: http://www.poliisi.fi/intermin/images.nsf/files/E19BA5BD6F160568C22579C200351C24/$file/myrskyselvitys_15032012.pdf

3. Externally, active communication is required, because it would boost civil preparedness and performance during hazard scenarios. This report has indicated how urban people are more dependent on electricity and telecommunications than those living in the countryside.
4. It is important for the development of a response strategy to keep in mind the whole spectrum of crises and emergency management measures. There are general, functional and regional aspects which should be observed and concerned.
5. Preparedness: What would be the added value from a response point of view, discussing, inter alia, such issues as the possibilities of member states pooling of resources (the question of organisation in sub-areas and their linkages).
6. Response: It could be considered by the EU whether there are any issues that could be addressed in regional settings within the issue area 'response'. While mostly those type of activities are more naturally in the 'preparedness' phase, this might also include joint operations of some kind, acknowledging the fact that response organizations are often following the neighbouring areas.
7. Recovery: Recovery-related assistance and cooperation are needed when resources and capabilities are insufficient. This can be on both a planned and ad hoc basis. The project could evaluate whether there are some issues where automatic and planned cooperation in recovery and restoration should take place. The main question here remains: is it likely that information about any obstacles/problems can be obtained?
8. Training and exercises: Training and exercises should be organised in a cross-sectoral and regional context; what would be the most important issues to be addressed in training, what could the other side teach the other that would be beneficial in practice, who would train whom?
9. Joint Operational capacities: A follow-up RAIN project could consider more practical ways of operating together, including such issues as standard operational protocols, and then doing this as practice over borders.
10. Injury prevention: A follow-up RAIN project could discuss the challenges of injury prevention seriously, in cooperation with safe communes and secure cities networks.
11. There are administrative, organizational and strategic challenges related to decreasing civil protection budgets within the Member States. Future policy should protect civil protection budgets within the Member States.
12. The wide range of actors – both national and multinational – are not fully involved nor sufficiently interlinked into EU disaster risk management (preparedness, response, consequence management) and critical infrastructure protection (CIP).
13. Better interoperability along with deeper organizational synergies is needed - across the sectors and borders.
14. Stronger EU partnerships and hybrid networks (academia, industry, small and medium-sized enterprises, agencies) allow better civil protection response and shared civil security capacities (compare military cooperation) and such relationships should be nurtured and encouraged.
15. Bringing all the systems together in a common or mutual system at a common policy level will be important for the citizens of the EU countries, and will also provide opportunities for more efficient and cost-effective emergency services.

16. It is a challenge to provide emergency response services in all EU languages. One solution to this problem that was outlined was that all callers are connected to their home country Emergency Response Centre (ERC) in order to get assistance in their native language.
17. There should be the same emergency number and the same responsible authorities in all countries. More information, with easier access and regular updates, should be put on the Internet, possibly via a joint EU 112-website.
18. The Baltic Sea Region should be seen as a potential area for the European-scale pilot project on efficient 112-cross-border cooperation and a single call centre to handle all 112 calls from several countries should be set up on a trial basis. So far, cross-border cooperation has been a very local issue, but it has worked rather well. However, it is recommended that higher-level basic agreements on cooperation are developed and implemented. The vision should be of a Baltic Sea Region (BSR) and European Union where in an emergency situation, one can get hold of adequate information in one's own language in order to protect oneself more effectively.
19. There should be direct technical connections between ERC's in different countries so that calls from other countries can be transferred with ease.
20. It is recommended that a system is put in place that when one travels, works or studies in another country, one should be able to understand given signals, signs etc. If in danger, (earthquake, a flood, avalanche etc.) one should be able to understand warnings/notifications. This can be achieved by developing a common emergency signalling system for the entire EU.
21. There is no shared understanding in Europe or in the BSR on the limits of cooperation or integration in civil protection but most actors agree upon the desirability of further integration and closer regional cooperation.
22. The following challenges and priorities are critical areas of concern for the whole disaster reduction process:
23. Risk assessments for decision making.
24. Reducing vulnerability and strengthening operational capacities as a priority.
25. Addressing new trends in hazard and vulnerability (NB Increase in extreme weather events).
26. Results and recommendations from risk assessment and mapping may create conflicts due to political and economic interests and thus require well-coordinated and established cross-border and cross-sectoral cooperation, exchange of information (including intelligence) and expertise, as well as the development of a cohesive regional safety culture through education, training and communication between all interested parties at regional, national and local levels.
27. There has been little analysis or investigation into the EU crisis-management performance related to new security threats, which may cause transnational emergencies affecting the whole Union.
28. Civil protection as a concept has not been specifically defined in all Member States.
29. Civil protection (CP) is a national competence, but it does not prevent states from requesting assistance through the EU's CP mechanism in case of an emergency that overwhelms national capacities. In order to receive such assistance, Member States need to develop adequate Host Nation Support structures and procedures.

30. Assessments of preparedness and simulations of crisis events are a valuable exercise. However, too often these types of exercise are designed, conducted and even evaluated by those who are practicing them. There is little space for real challenge and "external expertise" which would put the system on its limits and by doing this highlight shortcomings and gaps. A system of cross checking safety and crisis management between related stakeholders could be a feasible way of improving the effectiveness of these assessments.

It is important to note that a number of political-strategic level recommendations have already been implemented in the civil security framework of the EU and its CP Mechanism.

3.2 Operational-Tactical Level Recommendations

The operational-tactical level conclusions and the subsequent recommendations derived from the case studies of this report are as follows:

1. Electricity supplies should be secured in emergency situations. For instance, the Finnish Ministry of Employment and the Economy took measures after the storms of 2010 and 2011 that resulted in updating the Energy Market Act.[60]
2. Emergency Response Service should not get jammed. There should be more communication capacity and an emphasis on public awareness. People should be educated to have patience, and the number 112 is not the right place to call in a case of a regular electricity cut. Another national help line should be developed for lower priority events.
3. Civilian preparedness should be enhanced. Those in need should take an action and purchase generators (for example farms and other entrepreneurs). Civilians should have resources to survive a couple of days without electricity, especially in remote areas.
4. The officials' networks (such as TETRA) need to be developed. The maintenance during emergency situations should be improved and spread across European Union Member States with a common action policy.
5. Responsibilities of different officials should be set out clearly in future policy. For instance, in Finland the regional rescue departments are not responsible for helping to fix electricity lines. The responsible lies with the service provider.
6. Preparedness should be better coordinated and become a national requirement. Municipalities have various approaches to emergency situations. The approaches should be made similar. The role of state administrative agencies should be clarified and formalised in future policy.
7. The ways to produce situational pictures should be standardized and communication between administration levels should be improved. Such policy would allow for better cooperation in cross border events.
8. What is often desired by the end users and first responders is a joint command and control body with four essential characteristics: juridical power, operational capacity, technological advantage, and a political mandate. They are needed to avoid a too rigid sectoral structure,

60 Ministry of Employment and the Economy: Report 16.3.2012, p. 1. Available: http://www.tem.fi/files/32354/Muistio_TEMin_ehdotuksiksi_toimitusvarmuudesta_16032012_final_clean.pdf

which obstructs horizontal information flow and slows definition of the character of the actual crisis.

9. Enhanced role of citizens and volunteers support the work of first responders – particularly in rural and long distance areas. The bottom line is a better response with more coordinated action.

3.3 Conclusions of Case Study A: What Kind of Challenges Remain in Finland?

Before and during Tapani winter storm (2011) there was not enough situational data available for the citizens on how to prepare for the storm or act during the storm and repair efforts. This should be improved and more web-based open source information should be available and constantly updated.

External communications appeared to be avoided by officials. For example, Regional State Administrative Agency for South-Western Finland published only two releases during the storm, the first being published on 30th December, four days after the storm. Media was only used to disseminate official information, not as an active partner in providing situational awareness. The Rescue Commander for Western Uusimaa Rescue Region presented that journalists could be invited into command centre so that they would have immediate access to information. Public broadcasting company's reporters should at least have this role.

The winter storm of 2011 should be seen as a wake-up-call to officials. During past decades, use of electricity-based systems has increased, but there had not been sufficient emphasis put on back-up systems. Vital systems seemed to be secured prior to 2011, but other important features seem to have been forgotten (water services, telecommunication base stations).

The nationwide land transport system is controlled by the Finnish Transport Agency. This model could be supported and secured with more active public-private cooperation in order to guarantee sufficient resources in all weather conditions and in all parts of the country. The regional development work is a good example how the owners of critical infrastructures (i.e. private sector) are engaged to carry out disaster response and consequence management with the provinces and municipalities. This model should be further enhanced with governmental incentives and permanent working groups should be established to consider and update regional strategies for critical land transport infrastructure protection.

3.4 What Lessons Can Be Learned from Finland at EU Level?

It has been indicated that the Tapani storm has affected positively the preparedness and capability for emergency management. In 2013 the head of Security of the Government Council Mr. Timo Härkönen said in an interview at YLE that officials have improved their co-operation since the storms Tapani and Hannu.[61] Both telecommunication and electricity networks safety have improved since

61 YLE 17.11.2013. Available at:
http://yle.fi/uutiset/valtioneuvoston_turvallisuusjohtaja_aiemmista_myrskyista_on_opittu/6939058

Tapani. “Mobile networks are not so vulnerable anymore”, argued a representative of the Communication Bureau in an interview on 2014.[62]

Energy network safety has been improved and storms don't cause wide-spread power cuts anymore. The positive development was caused by the update of the Energy Market Act. A representative of the Energy Authority said in an interview that the electricity companies have complained a bit on the new law. “On the other hand, it is not too much to ask to take into consideration how dependent on electricity our modern societies are”, Mr. Simo Nurmi from the Energy Authority said to the newspaper Helsingin Sanomat.[63]

Civil preparedness has also been widely discussed since these recent storms. For example, the Finnish Red Cross has been campaigning for better civil preparedness. The Red Cross advises people to have at home food for a week, necessary drugs, candles, flashlights, batteries and so on. In 2013 a preparation rehearsal organized by the Red Cross gathered 10,000 people.[64]

3.5 Conclusions

This report has outlined the existing EU policy relating to crisis management and emergency response strategies. The discussion has shown that a reasonably comprehensive policy and procedure structure is already in place within the EU. However, the examination of the case studies outlined in Appendices A and B has highlighted weaknesses and limitations to current policies and procedures. Several recommendations are outlined in this report to inform and improve future policy decisions. This is by no means a definitive list of required policy and is intended to guide and facilitate the detailed discussion of the very intricate societal and political issues surrounding the development of future policy. By learning from past case studies, and attempting to foresee future requirements, it may be possible to reduce the negative consequences of extreme weather events through definitive and effective policy decisions.

62 Ilta-Sanomat 8.11.2014. Available: http://www.iltasanomat.fi/digi/art-1288764222660.html

63 Helsingin Sanomat 4.1.2015. Available: http://www.hs.fi/kotimaa/a1420340698412

64 Finnish Red Cross press release 16.3.2013. Available: https://www.punainenristi.fi/uutiset/20130216/noin-10-000-ihmista-osallistui-punaisen-ristin-sydantalvi-harjoitukseen; See also Finnish Red Cross campaign page https://www.punainenristi.fi/sydantalvi/talvimyrskyyn-voi-varautua

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Timo Härkönen, Government Council, Prime Minister´s Office

Veli-Pekka Ihamäki, Länsi-Uusimaa Regional Rescue Services

Peter Johansson, Itä-Uusimaa Regional Rescue Services

Janne Koivukoski, Ministry of the Interior of Finland

Terho Rajala, Police Board of Finland

Pekka Tiainen, Ministry of the Interior of Finland

Taito Vainio, Ministry of the Interior of Finland

Simo Wecksten, Helsinki City Rescue Department

CASE STUDIES: WEATHER HAZARDS AFFECTING CRITICAL INFRASTRUCTURE

Appendix A: Flooding of the Gulf of Finland 2005

Appendix B: Storm “ASTA” 2010

Appendix C: Hypothetical Scenario

A. Flooding of the Gulf of Finland 2005

Description of the Meteorological Event

The Finnish Institute for Marine Research (FIMR) received weather forecasts on 07 January 2005 showing that a strong winter storm was approaching Southern Finland. Operational wave and sea level model forecasts were checked by the FIMR staff, and they were told that something unusual may happen at sea. The comparative analysis of both Finnish and foreign models were conducted. The FIMR began to analyse the situation as model results differed considerably from each other. For example, for Helsinki the highest model forecast was +240 cm and the lowest +95 cm.

A forecast for the sea level in the Gulf of Finland was made based on model results and an assessment of the situation. The man-made forecast stated that the sea level might rise by up to +150 cm in Helsinki where the previous record was +136 cm. Furthermore, the forecast stated that the duration of the flood would be unusually long, lasting for several hours and including two peaks.

Situational awareness

Late on Friday afternoon (7th January) a severe weather outlook was issued for emergency authorities. A storm with winds of 25 m/s was forecasted for Saturday-Sunday night for southern and southwestern Finnish sea areas, and high winds for land areas. Waves could reach heights of up to 8 meters and there was a significant sea level rise in the Gulf of Finland by the evening of 08 January.

The sea level forecasting system used includes several models with different input data being automatically run four times a day. Observations and model results are saved on a database and foreign model results can be easily used for comparisons within the Baltic Operational Oceanographic System BOOS.[65]

Following the first early warning signals from the FIMR to the Ministry of Interior, the situation awareness of the Finnish emergency management agencies started to build on various assessments and predictions from the FMI's and the FIMR's forecast machinery. The signals were briefly noted and focused on essential details indicated as the following:

- Intense low pressure moves across central parts of the country to the east during the night between Saturday and Sunday.
- The southwest wind will become stormy on southern and southwest sea areas. On the North Baltic Sea as well as on the Gulf of Finland the wind will blow around 25 m/s.
- The wind will become dangerously strong in the land areas of the southern parts of the country until Sunday.
- Rain will reach Southwest Finland on Saturday afternoon and rainfall is in places predicted to be over 20 mm in the night between Saturday and Sunday.[66]

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[65] Pekka Alenius, Eurobaltic Seminar Report, - How to Use GIS Information in Risk Assessment and Policy Planning at the Central and Local Level, 29-30 May 2007, Helsinki, p 7.
[66] *Voimakas matalapaine lähestyy Suomea*. Ilmatieteen laitos 7.1.2005. Available:

- The storm is predicted to be as strong as was the Rafael-storm that caused wide economic losses in Finland and Sweden before Christmas 2004.
- The wind will be more than 25 m/s with gusts of almost 30 m/s.
- The wind will be dangerous in the land areas of Southern Finland. The strong wind can take down trees and damage rooftops. In the central parts of the country snow and sleet will cause severe road conditions.

On Saturday 08 January at 20:00 estimations showed that the new record height of sea level rise would not be reached in Helsinki. The evening forecast stated that the sea level would rise 110-140 cm higher than average and most likely the rise would be 130 cm. The North Baltic Sea FIMR's evening forecast still predicted a new record in wave height. The forecast was for 8 m waves and individual waves of 14-15 m.

Large-scale flood and storm damage was avoided, but water cut off roads and traffic in the coastal areas.[67] Traffic was cut off in many places in the Helsinki region. Routes that were partly cut off included Kehä I circle road in Otaniemi as well as intersection of Kehä III and Itäväylä. Traffic in Pohjoisranta and Pohjois-Esplanadi was also cut off. Water closed roads throughout the coastal region.

At 04:00 on Sunday 09 January, the FIMR announced that the sea level on the Gulf of Finland had risen to record heights. The wave height was almost a record on the North Baltic Sea, where the significant wave height was 7.2 m at its maximum. The record is still 7.7 m, measured during the Rafael storm before Christmas 2004.[68]

The FIMR's North Baltic Sea wave buoy did not make new wave height records as the storm centre passed the Baltic Sea a little farther south than was predicted. On all mareographies of the Gulf of Finland the sea level rose to a record height. Locally, the sea level in Turku was +130 cm (record before +127 cm); in Hanko +132 cm (+123 cm); in Helsinki +151 cm (+136 cm); in Hamina +197 cm (166 cm) and in St Petersburg, Russia, the sea level height was +239 cm, according to NWAHEM. In Loviisa the sea water level reached 173 cm according to energy company Fortum.

Following the first early warning signals from the FIMR to the Ministry of Interior, the situational awareness of the Finnish emergency management agencies started to take shape based on various assessments and multiple predictions fed from the FMI's and the FIMR´s forecast machinery.

A day before the storm, TV channel MTV3 released a story stating that that approaching storm was expected to cause record-high waves and sea level. The waves were forecasted to be dangerously high for small vessels. There was a warning of flooding for many places on the coasts of Gulf of Finland. Significant wave high was forecasted to be over 9 m in Northern Baltic Sea and over 5 m in the Gulf of Finland. It should be noted that when big passenger ferry M/S Estonia sunk, waves were

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http://www.fmi.fi/uutiset/index.html?A=1&Id=1105103998.html

[67] *Myrsky ei aiheuttanut pahoja tuhoja Suomessa.* MTV3.fi 9.1.2005. Available: http://www.mtv3.fi/uutiset/arkisto.shtml/arkistot/kotimaa/2005/01/341243

[68] *Vedenkorkeus nousi Suomenlahdella ennätyslukemiin, aallokko oli hyvin korkeata, vaikka uusia ennätyksiä ei aivan syntynytkään.* Itämeriportaali 9.1.2005. Available: www.itameriportaali.fi/fi/uutisarkisto/2005/fi_FI/950

4.2 m high.[69] Highest waves were expected to be up to 16–18 m. In Helsinki, sea level was expected to rise to 1.40 m and beat the previous record by 4 cm. The Marine Research Unit warned that the market place Kauppatori in Helsinki would flood.[70]

The term 'situational awareness' was relatively new in Finland as it came into use more broadly after the South East Asian tsunami of 2004. In 2006, the Finnish government established a warning Centre for natural disasters. Organizations involved in the Centre include the Finnish Meteorological Institute (FMI), the FIMR, and the Department of Seismology of the University of Helsinki. An early warning system has begun to be built up, which makes it possible to anticipate the likelihood of severe weather up to two weeks in advance. Early warning information was distributed via a severe weather outlook e-mail list, which has 150 members including the Ministry of the Interior, State Provincial Offices, Emergency Response Centres, Police, Finnish Maritime Administration, and the Finnish Border Guard.

These severe weather outlooks aim to promote rescue organizations to reallocate their resources, distribute personnel to risk-prone areas, to prepare rescue equipment, and to be ready to fix telecommunication breaks. A survey conducted by FMI in 2007 revealed that 80% of early warning outlooks were considered helpful for the preparation of rescue activities.[71]

Management of Emergency

Local and municipal level

Regarding the flow of strategic early warning information highlighted that the sea level was predicted to rise to record heights on the Gulf of Finland. At that time the sea water reached Helsinki City Centre and caused alarming conditions to the critical infrastructures such as the Presidential Palace, which is located by the quay. This earlier record height was measured on 27 January 1990 and records have been kept since 1904.[72]

The operational situational awareness was evolving well both at the central and regional levels of the Finnish rescue services and other response institutions. The situational knowledge, i.e. deeper and comprehensive understanding of the duration and severity of the incident and its larger implications, started to generate management of the situation. The Finnish Meteorological Institute announced that difficult weather conditions would be over by Sunday evening. Dangerous weather should have

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[69] M/S Estonia sunk on 28.9.1994 when it was en route from Tallinn to Stockholm. Over 850 people died in the accident, which was one of worst maritime desasters of the century on the Baltic Sea. See also http://en.wikipedia.org/wiki/MS_Estonia

[70] *Suomea lähestyvä myrsky uhkaa nostattaa ennätysaallot*. MTV3. Kotimaa. 07.01.2005 Available: http://www.mtv.fi/uutiset/kotimaa/artikkeli/suomea-lahestyva-myrsky-uhkaa-nostattaa-ennatysaallot/1980432

[71] Martti Heikinheimo, Eurobaltic Seminar Report, - How to Use GIS Information in Risk Assessment and Policy Planning at the Central and Local Levels?, 29-30 May 2007, Helsinki, p 7.

[72] *Aallokko- ja vedenkorkeusvaroitus pohjoiselle Itämerelle ja Suomenlahdelle.* Itämeriportaali 7.1.2005.

passed on Sunday evening at latest.[73] On the North Baltic Sea the wind can be 28 m/s and on the western Gulf of Finland 25 m/s.[74]

Figure 6: Finnish coastal region where January flooding of 2005 took place. (Maanmittauslaitos. Karttapaikka)[75]

National and government level

The national flood response system generated its operational preparedness after the Rescue Service Unit (RSU) of the Ministry of the Interior received early warning about the rising sea level and oncoming storm from the FIMR and the FMI on the afternoon of 07 January.

Because this flood warning affected several rescue departments, the information was first passed to the State Province Offices of Western and Southern Finland that further contacted the rescue departments on the affected areas and passed the information further.[76] After going to the rescue departments, the information was passed to the Finnish Environment Institute and Ministry of Agriculture and Forestry as well as to the Government situation centre. The Government Situation Centre informed ministers about the events.[77]

On Saturday 08 January, the Rescue Service Unit of the Ministry of Interior decided that a meeting of the (emergency) preparedness leaders would be held at 9 pm. The meeting took place between the preparedness leaders from the essential governmental agencies as well as experts from the FMI and the FIMR to give the most accurate forecasts of the storm. Representatives of the Coast Guard and the Police on call were also present. The State Province Offices of Western and Southern Finland were asked to give their reports on the preparedness of the coastal areas in the meeting.[78] The role

[73] *Hankala sää jatkuu sunnuntai-iltaan.* Ilmatieteen laitos 8.1.2005.
[74] *Voimakas talvimyrsky lähestyy Suomea.* YLE 24 9.1.2005.
[75] Maanmittauslaitos, karttapaikka. Karttakuva rannikkoseudusta. Available: https://asiointi.maanmittauslaitos.fi/karttapaikka/
[76] Interview with Rami Ruuska on 29.5.2007
[77] Interview with Taito Vainio on 25.5.2007
[78] Duty record of the Rescue Service Unit of the Ministry of the Interior

of the meeting was to see that things were under control and that the ministries were aware of their responsibilities, and that all responsibilities were appropriately taken care of.[79] At 9 pm in the meeting of the (emergency) preparedness leaders, the forecasts from the FMI and the FIMR were dealt with, as well as the preparedness of the regions involved. The state of readiness was officially noted as well as the fact that at this point no special actions were expected from the side of the Finnish government. It was also decided that a more detailed communication, based on the most recent forecasts, would be given to the public. Also different branches of administration would be advised to prepare themselves with adequate resources.[80] One could assume that the shortcomings of the national crisis communications during the tsunami disaster had revived the readiness of the government authorities to activate and inform the public about the situation. This could be described as widened situational knowledge, or as the mobilization of the first responders – citizens themselves.

Following the critical decision making mechanism i.e. (emergency) preparedness leaders meeting on 08 January the Ministry of Interior advised citizens to be cautious and the rescue departments of the City of Helsinki and Southwest Finland recommended citizens to avoid going outdoors if possible.[81] This was also the first time that the ministry issued a warning and notice to the public by direct radio broadcast.[82]

The (emergency) preparedness leaders meeting paved the way for several other semi-governmental agencies to issue their own early warning signals and to raise their profile as the responsible agency to deal with. For instance, the Finnish Environment Institute (SYKE), which operates with the support of the Ministry of Environment and is responsible for a wide range of natural and man-made risks, such as oil spills, announced that the storm would bring rains that could cause flooding in the rivers on the south coast and in southwest Finland. Water levels in rivers might rise around one meter and also lake levels could rise around 20 cm.[83] The Finnish Maritime Administration estimated that the storm would be the strongest in the last hundred years and urged mariners to stay in harbour or not to try to come to harbour from open sea until the storm was over. The Finnish Maritime Administration also increased its preparedness for the sea traffic control and monitoring.[84]

The Finnish Road Administration warned of very poor road conditions in the southern and southwestern coastal areas.[85] Road conditions also in central Finland were expected to become very

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[79] Interview with Taito Vainio 25.5.2007
[80] Duty record of the Rescue Service Unit of the Ministry of the Interior
[81] Duty record of the Rescue Service Unit of the Ministry of the Interior
[82] Lecture of Janne Koivukoski: *Fluently information sharing between authorities and GIS; Good experiences and luck* in Eurobaltic II Workshop on "Risk Management – How to use GIS information in risk assessment and policy planning at the central and local levels?" 29.5.2007 in Helsinki.
[83] *Sunnuntaiyöksi luvassa voimakas talvimyrsky.* YLE 24 8.1.2005. Available: http://www.yle.fi/uutiset/haku.php?action=page&id=178188&search=tulv*
[84] *Pelastusviranomaiset varoittavat myrskystä.* MTV3.fi 8.1.2005. Available: http://www.mtv3.fi/uutiset/arkisto.shtml/arkistot/kotimaa/2005/01/341178
[85] *Pelastusviranomaiset varoittavat myrskystä.* MTV3.fi 8.1.2005. Available: http://www.mtv3.fi/uutiset/arkisto.shtml/arkistot/kotimaa/2005/01/341178

poor.[86] In Estonia, the newspaper *Postimees* warned of the coming storm and forecasted a sea level rise in Pärnu of at least 2.4 m above the normal level and at the coastal areas in general at least 1.5 m. Sea level was also predicted to rise on the coast of the City of Haapsalu.[87] These pieces of information from Finland and Estonia were added by the Government Council to the earlier situational picture, and as such served for the common cause of mobilising the wider society to deal with sudden flash flooding.

The storm Gudrun, as it was called in Sweden, caused severe damage in Southern and Western Sweden. Swedish public TV SVT described the night when Gudrun hit Sweden as a "night that changed everything". SVT published a series of stories 10 years after the storm, in January 2015.[88]

According to SVT, winds speeds were hurricane-strong, over 40 meters per second in gusts on the coast. Electricity lines suffered faults, mobile network went down, roads were blocked and railway traffic stopped. A year's harvest worth of trees fell: 200 million pieces. A total of 75 million cubic meters of timber was damaged. In some places, 50–60 per cent of wood was damaged. According to newspaper Dagens Nyheter, 17 people were killed because of the storm.[89]

There was a new flood warning on the coastal area of Estonia on Monday. The water level was dropping on the streets of Pärnu, but the Estonian Rescue Centre asked Pärnu's residents to wait out for a possible new storm before returning home. More than 400 people were evacuated from Pärnu. Most of the evacuees were in spa hotels, which are popular also among Finnish tourists. Most of the Finnish tourists that had been evacuated from the spa hotels returned to Finland on Monday. The spas in the city of Haapsalu were spared evacuation. In Kuresaari there were no evacuations from the spas, and already new tourists from Finland arrived there on Monday.[90]

Estonia's government held a crisis meeting on Tuesday, where they estimated the storm damage as well as the success of the rescue work throughout the country.[91] A third of Estonians were experiencing electricity blackouts, and sea water flooded into hundreds of apartments in coastal areas. The storm damaged roofs and felled trees throughout the country. At least 15 people were injured. In Pärnu, Saarenmaa and Jõgevassa most of the schools were closed on the Monday. In Pärnu the storm destroyed about 40,000 hectares of forest, and killed sheep, cows, and other livestock. The damage in the province of Pärnu alone was estimated to be about 200-300 million kronas (€20-30 million). In Pärnu the flood was a record high in 295 cm and sea waters were advanced two kilometres from the shore to the inland.[92] Tthe sea level rose record-high: +2.95 m above regular sea level. Later, it was corrected to be +2.72 m.[93] In Haapsalu, 103 people were

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[86] *Helsinki torjui tulvaa paperipaalein.* Helsingin Sanomat 9.1.2005, A6.
[87] *Virossa varoitettiin veden noususta.* Helsingin Sanomat 9.1.2005, A6.
[88] SVT 7.1.2015: http://www.svt.se/nyheter/regionalt/hallandsnytt/tio-ar-sedan-stormen-gudrun
[89] *Stormen orsakade 17 dödsfall*. Dagens Nyheter 20.1.2005.
Available: http://www.dn.se/nyheter/sverige/stormen-orsakade-17-dodsfall/
[90] *Viron rannikolle uusi tulvavaroitus.* Helsingin Sanomat 11.1.2005, A7
[91] *Viron rannikolle uusi tulvavaroitus.* Helsingin Sanomat 11.1.2005, A7
[92] *Viron rannikolla valmistauduttiin jo uuteen tulvaan.* Aamulehti 11.1.2005, A5
[93] *Pärnus võib merevee tase tõusta kriitilise piiri lähedale.* Delfi 18.12.2011: Available at:
http://ilmateade.delfi.ee/uudised/parnus-voib-merevee-tase-tousta-kriitilise-piiri-lahedale?id=63497774

evacuated. For example Holmi peninsula was cut off and circled by water, and people were evacuated (see Figure 5 for an example of the flooding in Haapsalu).[94]

Figure 7: Flooding in Haapsalu in January 2005. (Juri Kurba, Viimsi vald)[95]

On 09 January, the emergency commission of West-Estonian Islands (Saaremaa, other islands around as well as Ruhnu on Pärnu Bay) described the situation to be critical. Ferries between mainland and islands were not in operation because of the storm, so islanders were isolated. Roads in the main city Kuressaare in Saaremaa island were flooding.[96]

After the storm, a crisis commission of government initiated an investigation, asking if the storm had been forecasted well enough, said the ERR on 14 January. The storm was described to be the worst in a decade and the commission suggested that people should be better informed, if a hazardous weather system was approaching Estonia.[97]

Consequence management

[94] *Haapsalus evakueeriti üle saja inimese /täiendatud/.* ERR 9.1.2005. Available at: http://uudised.err.ee/v/234f46e1-e306-4d06-9fd6-e75f83671a38

[95] Juri Kurba. Viimsi vald. 2016.

[96] *Saare kriisikomisjon hindas olukorda tõsiseks* ERR 9.1.2005: Available: http://uudised.err.ee/v/90d9a2ab-5c1c-43ae-8765-4a29e46af4da

[97] *Riik otsib puudujääke ilmaennustuses.* ERR 14.1.2005. Available at: http://uudised.err.ee/v/6ca3e8be-ca90-4a03-b675-49eeffd31145

Besides the parallel experiences of the tsunami disaster, Finland was hit by the Rafael storm a couple of weeks earlier. This may have prepared the authorities for this storm because the Rafael-storm made the rescue systems highly attuned and alert.[98] The first responders were the few governmental agencies that started their response operations already on 07 January after the first signs of severe weather conditions, and the West Finland Coast Guard and the Gulf of Finland Coast Guard were preparing for the storm by raising the alert. On 07 January their helicopters were on standby at Turku and Helsinki-Malmi airports, according to Lieutenant Jim Johansson from the Gulf of Finland Coast Guard.[99] The Finnish Road Administration was also prepared for the storm and problems that it would entail. The amount of people working through the weekend was increased.

The Chief of the Traffic Management Centre, Veli-Pekka Pelttari, estimated that trees and pylons would be blown down onto roads, and the roads could be covered by rising water.[100] Within the private sector, which owns most of the critical infrastructures, the situation was taken seriously and with preparatory measures as well. The exceptions were the railway company VR, which was not prepared specifically for the storm, although there could have been problems if trees were to fall across rail tracks. The national airline carrier Finnair reported that the storm would not cause any disruptions to its operations.[101]

During the previous Rafael-storm, the energy company Fortum Oyj had faced problems with the distribution of electricity, because the storm damaged power transmission lines, which were still being fixed in southwest Finland and in west Uusimaa.[102] This case looked somewhat more alarming for Fortum's business strategy. The company had elevated its storm preparedness in southwest Finland and in west Uusimaa. A large amount of service personnel was ready to be mobilized if needed and 200 employees were ready to work on Sunday in case of widespread damage.[103]

Large passenger ships operating in the Gulf of Finland were also prepared for being behind schedule because of the storm. Passengers were warned to prepare for cancellations in the traffic between Finland and Estonia. High-speed ships between Helsinki and Tallinn would not operate if wave heights were more than 3 meters.[104] The captain of the ship would make the decision to depart case-specifically, depending on the weather conditions.[105] According to Viking Line, one of the two major ferry operators, storms were not expected to affect the operation of the large ships, but smaller ships might be delayed. According to the technical director of Viking Line, Kaj Jansson, the

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[98] *Sunnuntaiyöksi luvassa voimakas talvimyrsky.* YLE24 8.1.2005. Available at: http://www.yle.fi/uutiset/haku.php?action=page&id=178188&search=tulv*
[99] *Itämerelle luvassa ennätysaallokko*. Helsingin Sanomat 8.1.2005, A7
[100] *Itämerelle luvassa ennätysaallokko*. Helsingin Sanomat 8.1.2005, A7
[101] *Voimakas talvimyrsky lähestyy Suomea.* YLE24 9.1.2005. Available: http://www.yle.fi/uutiset/haku.php?action=page&id=178199&search=tulv*
[102] *Itämerelle luvassa ennätysaallokko*. Helsingin Sanomat 8.1.2005, A7
[103] *Helsinki torjui tulvaa paperipaalein*. Helsingin Sanomat 9.1.2005, A6
[104] *Matkustajalaivat saattavat myöhästellä myrskyn vuoksi.* Aamulehti 8.1.2005, A5
[105] *Suomea lähestyvä myrsky uhkaa nostattaa ennätysaallot.* MTV3.fi 7.1.2005. Available: http://www.mtv3.fi/uutiset/arkisto.shtml/arkistot/kotimaa/2005/01/341011

situation was not as bad as was predicted.[106] But TallinkSilja, the Estonian ferry operator, prepared for running late and for timetable changes.

In general, the storm situation was followed carefully within maritime traffic and ships were able stay in port to wait for the storm to subside.[107] In large passenger ships trucks were strapped down on the car decks, whereas normally only their detachable rears would be secured.[108] The ships to Stockholm left normally on Saturday night, but Tallink Silja cancelled its operations from the Estonian harbours. The last high-speed ships running between Tallinn and Helsinki were in Helsinki before the storm was due to hit.[109] The City of Helsinki Rescue Department prepared for the storm and the flooding of Kauppatori by a new method, which was to dam up Kauppatori using massive paper bales a meter high. There are good case studies on the re-use of massive paper bales in Great Britain. These are quicker to move and build than the traditionally used sand bags. In Helsinki the flood barrier was built first in Kauppatori, because experience had showed that sea level always rose there first. The rescue department would get technical assistance and know-how from the Finnish Defence Forces conscripts and preparedness groups of the civil service departments of city of Helsinki as well as from volunteer groups when necessary. The City of Helsinki Rescue Department has a group of 80 men ready on three-minute standby during weekends.[110]

On Saturday afternoon of 08 January, the Helsinki's volunteer fire brigade built flood barriers in the city centre.[111] It was predicted that the water would rise to Kauppatori, but the City Hall and the Presidential Palace would be expected to be safe since the predicted water rise was not enough to reach them. Since Friday 07 January units of the rescue department had been monitoring the sea level at nine different locations in Helsinki. There were for instance units in Kauppatori, Vattunokka, Iso and Pikku-Huopalahti, Töölönranta 14 and Kyläranta. Fire fighters were on call the whole night between Saturday and Sunday.[112] The flood barrier in Kauppatori was 300-400 m long.[113] In addition to the rescue department, the Police, Helsinki Water, the Port of Helsinki, the Public Works Department, the Environment Centre of the City of Helsinki, the volunteer fire brigades and the Finnish Defence Forces were on standby to prevent flood damage.[114] For instance, Helsinki Water offered sand bags to members of the public, first responders, to tackle flash floods.[115] It also started to seal off sewer overflows so that sea water would not get into buildings through drains.[116]

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[106] *Yön raivonnut vuosisadan myrsky heikkenee tänään.* Aamulehti 9.1.2005, A5
[107] *Suomea lähestyvä myrsky uhkaa nostattaa ennätysaallot.* MTV3.fi 7.1.2005. Available at: http://www.mtv3.fi/uutiset/arkisto.shtml/arkistot/kotimaa/2005/01/341011
[108] *"Luvassa kovaa länsituulta"*. Helsingin Sanomat 9.1.2005, A6
[109] *Helsinki torjui tulvaa paperipaalein.* Helsingin Sanomat 9.1.2005, A6.
[110] *Helsingin Kauppatori padotaan tarvittaessa paperipaalein.* Helsingin Sanomat 8.1.2005, A7
[111] *Helsinki torjui tulvaa paperipaalein*. Helsingin Sanomat 9.1.2005, A6
[112] *Helsinki torjui tulvaa paperipaalein*. Helsingin Sanomat 9.1.2005, A6
[113] *Rannikko valmistautui myrskyn lähestymiseen.* Aamulehti 9.l.2005, A5
[114] *Helsinki torjui tulvaa paperipaalein*. Helsingin Sanomat 9.1.2005, A6
[115] *Helsinki torjui tulvaa paperipaalein*. Helsingin Sanomat 9.1.2005, A6
[116] *Voimakas talvimyrsky lähestyy Suomea.* YLE24 9.1.2005. Available: http://www.yle.fi/uutiset/haku.php?action=page&id=178199&search=tulv*

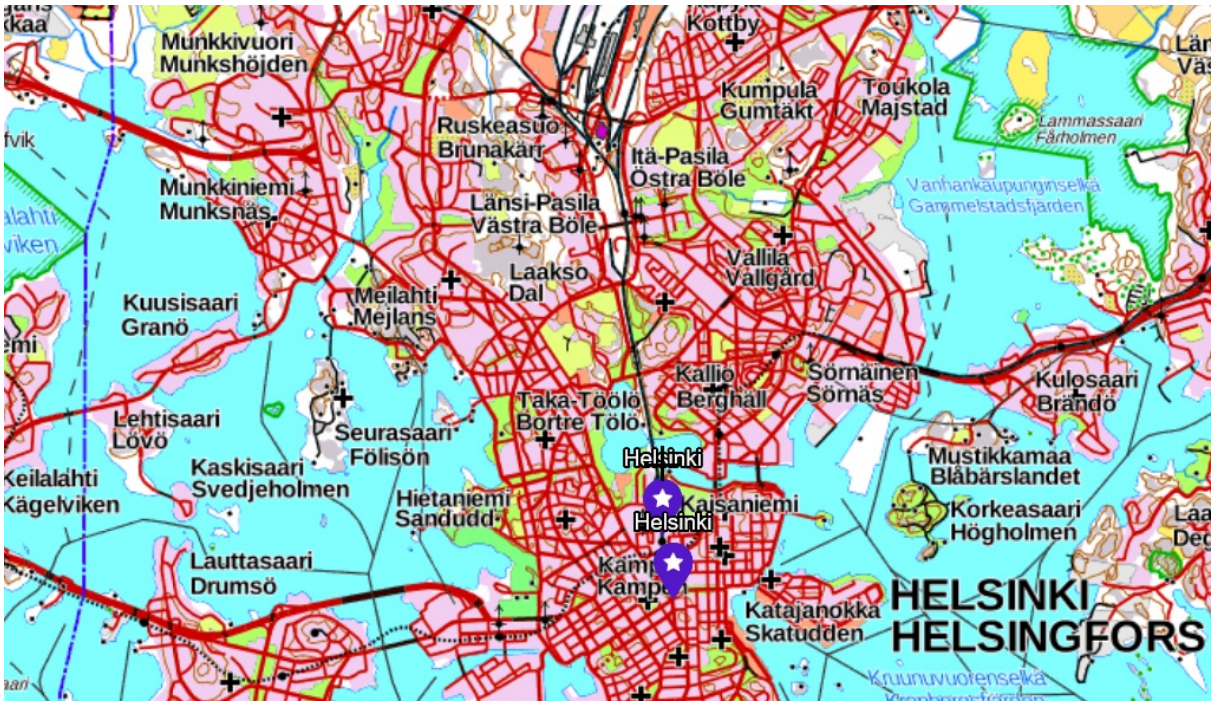

Figure 8: Helsinki city. (Maanmittauslaitos, karttapaikka)[117]

The storm that raged during the night was expected to calm down on the Sunday night, 09 January. According to the Finnish Meteorological Institute (FMI), wind could still be dangerous on land areas in the southwest Finland and in the west Uusimaa region, especially on midday Sunday. The FMI estimated that the worst gales passed Finland from the south. The storm was at its worst in Great Britain, Denmark, southern Sweden and the Baltic countries.[118] The storm warning was in force until Sunday evening, but according to the FMI, wind was gradually decreasing during Monday night. During Sunday night the wind would be on southern sea areas 16-23 m/s, in Hanko gustily at 27 m/s.[119]

At 04:00 on Sunday 09 January, the FIMR announced that the sea level on the Gulf of Finland had risen to record heights. The wave height was almost a record on the North Baltic Sea, where the significant wave height was 7.2 m at its maximum. On all mareographies of the Gulf of Finland the sea level rose to a record height. Locally, the sea level in Turku was +130 cm (record before +127 cm); in Hanko +132 cm (+123 cm); in Helsinki +151 cm (+136 cm); in Hamina +197 cm (166 cm) and in St Petersburg, Russia, the sea level height was +239 cm, according to NWAHEM.[120]

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[117] Maanmittauslaitos, karttapaikka. Available: https://asiointi.maanmittauslaitos.fi/karttapaikka/

[118] *Yön raivonnut vuosisadan myrsky heikkenee tänään.* Aamulehti 9.1.2005, A5

[119] *Myrskyn nostama vesi tulvi teille ja kellareihin.* YLE24 10.1.2005. Available: http://www.yle.fi/uutiset/haku.php?action=page&id=178221&search=tulv*

[120] *Vedenkorkeus nousi Suomenlahdella ennätyslukemiin, aallokko oli hyvin korkeata, vaikka uusia ennätyksiä ei aivan syntynytkään.* Itämeriportaali 9.1.2005. Available: www.itameriportaali.fi/fi/uutisarkisto/2005/fi_FI/950

According to the FIMR, on the Gulf of Finland the sea level was at a record high for an exceptionally long time. The level dropped slightly but then rose again during the morning back to the same. Sea level started to fall at about 14:00 on Sunday afternoon. This exceptional situation was caused by the synergy of a strong west wind, deep low pressure and the fluctuation of the sea level in the Gulf of Finland. The sea level rose on the coast of Finland by almost a metre during Friday and Saturday nights and dropped to about 0.5m in the daytime on Saturday. The sea level rose again in the Gulf of Finland by about a metre on Monday. The sea level on the Gulf of Bothnia also increased greatly, but did not break any former records.[121]

Aftermath (13-14 Jan)

A new storm approached Sweden and Finland during the night between Thursday and Friday (13-14 Jan). According to the Finnish Meteorological Institute, the wind was not predicted to be as stormy as it was during the previous weekend. The risk of severe floods would decrease in the rivers and lakes of south and southwest coast. Rising water levels would stop, if the rain were to cease during the coming weekend, as was predicted. The level of the inland waters of the region was above average. According to senior inspector Leena Villa of the Environment Centre of Uusimaa, the water was not the threat to houses it had been the week before. In Vantaanjoki the water was 1.8 m higher than average.[122] The Finnish Institute of Marine Research (FIMR) warned that sea level could rise by 1.2 m in Helsinki and even 1.5 m in Kemi during Thursday night. On Wednesday morning, the sea level was 85 cm above average.[123] The City of Helsinki Rescue Department was again preparing for the sea level to rise along coastal areas. The rescue department had an operation going on in the Marjaniemi seaside residential area, where around 20 houses had suffered water damage. The Rescue Department, the Public Works Department of Helsinki and the Waterworks, together with three volunteer fire brigades, banked up the bay area with sand bags. Some of the houses at the area suffered water damage already during the flood and storm the previous weekend. According to the fire chief on call, Juha-Pekka Lassila, the sea water can cause damage if the sea level rises by more than 120 cm above average. At around noon the sea level was 91 cm above average on the Helsinki coast.[124] The decision to build flood barriers was made in the morning, when it still seemed that the sea level would rise by more than 120 cm above average and would cause damage. The barrier was ready in place in the afternoon, when the sea level was 94 cm above average.[125]

According to the forecast of the FIMR on Thursday night, the situation was predicted to remain calm, because the sea level had started to fall. At 20:00 the sea level was 88.5 cm and falling. The highest point the sea level reached was 95 cm.[126] Juha-Pekka Lassila stated in the evening that the sea level

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[121] *Vedenkorkeus nousi Suomenlahdella ennätyslukemiin, aallokko oli hyvin korkeata, vaikka uusia ennätyksiä ei aivan syntynytkään.* Itämeriportaali 9.1.2005.
[122] *Uusi myrsky lähestyy*. MTV3.fi 12.1.2005. Available: http://www.mtv3.fi/uutiset/arkisto.shtml/arkistot/kotimaa/2005/01/342103
[123] *Merenpinta lähtee uuteen nousuun.* YLE24 13.1.2005. Available at: http://www.yle.fi/uutiset/haku.php?action=page&id=178281&search=tulv*
[124] *Helsingissä varaudutaan uusien tulvien varalta.* MTV3.fi 13.1.2005. Available: http://www.mtv3.fi/uutiset/arkisto.shtml/arkistot/kotimaa/2005/01/342431
[125] *Myrsky riepotteli taas etelärannikkoa.* Helsingin Sanomat 14.1.2005, A8
[126] *Vedenpinta lähti laskuun Helsingissä.* MTV3.fi 13.1.2005. Available:

rise did not result in more work for the rescue department. Meteorologist Petri Hoppula from the FMI estimated that the storm on Thursday was much weaker than the storm of the weekend.[127] In Turku the sea rose again to the area of the port of Turku and surrounded the hotel Seaport and the passenger terminals of the large passenger ships.[128] The sea level was about a metre above average. The temporary routes to the ships were re-built.[129]

The Finnish Environment Institute (SYKE) warned that rain and melting snow caused by the storm had raised the levels of rivers and lakes in southwest Finland and the south coast to flood heights. The water levels in lakes were estimated to continue to rise and new rains and warm weather had been forecasted after a short cooling down. The water flow in rivers was considerably heavy for this time of year in southwest and south Finland. This kind of flow is typical for spring time. High sea level also raised water levels in river deltas, and flood problems emerged in the Kokemäenjoki and Loimijoki rivers. The weather forecasts predicted that the level of water in all southwest and south Finland's lakes would raise again to unseasonable highs during the following week. [130] At this stage the rest of the emergency authorities realized that the situation might not be over. During the night of Sunday and Monday 9-10 January there were no new emergency assignments for the rescue departments because of the flood. Most of the roads that were cut off by the flood had been reopened to traffic and the water had been pumped from the cellars of private houses.[131] However, the flood still meant work for the Helsinki rescue departments on Monday. The pumping of the water from the tunnels continued, but the situation was seemingly under control in parts of these underground critical infrastructures, where district heating, electricity, phone, water and sewage lines lie in tunnels dozens of kilometres long. Water was also pumped out of the metro transformer booths. The massive paper bales and the sand bags were removed from Kauppatori, central market square by the sea, on Monday morning.[132]

The pumping of the water out of the many private houses was mostly done by Monday noon. In many places dryers replaced pumps (drying work can last for weeks). In Helsinki the worst situation was still in Marjaniemi, but also houses in Tammisalo, Laajasalo and Kulosaari were flooded, according to Helsinki Water's production manager Petteri Niemi. Paradoxically, these areas are traditionally regarded as the most secure and valued residential areas in Helsinki. In other places in Helsinki flooding was due to sea water blocking up sewers. Sea level was so high that it got into the sewage systems. As a result of the overload of the sewer network, 63,000 cubic meters of untreated waste water was dumped into the sea. About 100 buildings in the Helsinki region were in need of

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http://www.mtv3.fi/uutiset/arkisto.shtml/arkistot/kotimaa/2005/01/342570

[127] *Myrsky riepotteli taas etelärannikkoa.* Helsingin Sanomat 14.1.2005, A8

[128] *Myrsky riepotteli taas etelärannikkoa.* Helsingin Sanomat 14.1.2005, A8

[129] *Myrsky riepotteli taas etelärannikkoa.* Helsingin Sanomat 14.1.2005, A8

[130] *Järvien vedenpinnat jatkavat nousuaan Etelä- ja Lounais-Suomessa.* Suomen ympäristökeskus 10.1.2005. Available: www.ymparisto.fi/default.asp?contentid=113654&lan=FI

[131] *Tulvatilanne rauhoittunut.* MTV3.fi 10.1.2005. Available: http://www.mtv3.fi/uutiset/arkisto.shtml/arkistot/kotimaa/2005/01/341365

[132] *Myrskyvahinkoja korjailtu.* MTV3.fi 10.1.2005. Available: http://www.mtv3.fi/uutiset/arkisto.shtml/arkistot/kotimaa/2005/01/341634

rescue. In Hamina, where the sea level rose 198 cm, more than 200 places needed help from the Rescue Department.[133]

According to Rescue Commander Kari Lehtokangas, the prevention of the flood damage in Helsinki was successful: "Action was taken in time, when the weather forecasts were given." Private home owners called the Rescue Department and asked what they should do, and the rescue department's crew went to advise them at their location. The City of Helsinki Rescue Department considered updating its preparedness plans. According to Lehtokangas, it is good to question whether one should build on the waters' edge with the risk that the building's ground floor could be flooded once every 20-30 years. In Finland, the responsibility of the safety of the building sites belongs to the municipalities' city planning and construction licence policy.[134]

According to the Finnish Road Administration's Traffic Management Centre, traffic was running smoothly already on the Monday morning. The morning traffic was not exceptional, contrary to what was expected on the Sunday.[135]

Material damage

Passenger ferries on route Helsinki and Stockholm were operating in time, but operations between Helsinki and Tallinn were cancelled during the storm. Helsingin Sanomat stated that thousands of people, destined for Helsinki, had to stay an extra night in Tallinn.[136]

The Turku City harbour was also flooding. Some cars parked at the harbour parking area were damaged. The basement of Hotel Seaport, located in the harbour, was flooding. Regional newspaper Turun Sanomat stated that around 10 customers of the hotel were evacuated from first floor to second floor. Conference rooms on the basement had around 20 cm of water on the floor. Terminal infrastructure was suffering faults and departing or arriving passenger had difficulties boarding the ferries. Some rescue brigade volunteers were called in to build temporary transit bridge for passengers.[137]

On 12 January, Helsingin Sanomat stated that flooding was "not threatening Helsinki". City planning had noticed the hazard scenario of flooding. Housing regulations required that houses be built 2.5–3 metres above sea level. If sea level rises dramatically, it would also be possible to build a wall to protect the city. However, there are areas in the city that are prone to flooding, like the area of Marjaniemi. Some detached houses there are only 1.2 metres above sea level. Also, central areas and Töölö Bay have a relatively low elevation. A representative of Helsinki City geotechnical

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[133] *Vakuutus ei välttämättä korvaa tulvan aiheuttamia vahinkoja.* Helsingin Sanomat 11.1.2005, A7
[134] *Vakuutukset korvaavat, kun tulva johtuu myrskystä.* Aamulehti 11.1.2005, A5
[135] *Ennätysaaltoja selittää etelätuuli.* Aamulehti 9.1.2005, A5
[136] Helsingin Sanomat 10.1.2005 (retrieved from newspaper's archive. Available at: http://www.hs.fi/paivanlehti/arkisto/Suomenlahti+tulvi+%C3%A4k%C3%A4isesti+kaduille+ja+taloihin/aaHS20050110SI2YO01s30?src=haku&ref=hs-navi-paivanlehti.)

[137] Turun Sanomat 10.1.2005. Available: http://www.ts.fi/uutiset/kotimaa/1074018014/Veden+saartaman+satamahotellin+asukkaat+kulkivat+veneella

department said that hopefully the flood scenario would be paid more attention in the future, after the floods of January 2005.[138]

On 16 January, Helsingin Sanomat met some of the people evacuated from their homes in Virolahti. They had to dry and renovate their houses and to live elsewhere "for months". A resident of Virolahti said that he does not recall if there ever was flooding as bad as in January 2005. Not even floods of 1967 or 1986 were that bad, Mr Mauri Kimmo said.[139]

Large-scale flood and storm damage was avoided, but water cut off roads and traffic in the coastal areas.[140] Traffic was cut off in many places in Helsinki region. Routes that were partly cut off included Ring Road I in Otaniemi as well as intersection of Ring III and Itäväylä. Traffic in Pohjoisranta and Pohjois-Esplanadi was also cut off. Water closed roads throughout the coastal region.[141]

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[138] Helsingin Sanomat 12.1.2005 (retrieved from newspaper's archive. Available at: http://www.hs.fi/paivanlehti/arkisto/It%C3%A4meren+nousu+ei+ole+suuri+uhka+Helsingille/aaHS20050112SI1KA030nl?src=haku&ref=hs-navi-paivanlehti)

[139] Helsingin Sanomat 16.1.2005 (retrieved from newspaper's archive. Available at: http://www.hs.fi/paivanlehti/arkisto/Suomenlahden+veden+nousu+ajoi+asukkaat+kuukausiksi+evakkoon/aaHS20050116SI1YO05oaa?src=haku&ref=hs-navi-paivanlehti)

[140] *Myrsky ei aiheuttanut pahoja tuhoja Suomessa.* MTV3.fi 9.1.2005. Available: http://www.mtv3.fi/uutiset/arkisto.shtml/arkistot/kotimaa/2005/01/341243

[141] *Suomenlahti tulvi äkäisesti kaduille ja taloihin.* Helsingin Sanomat 10.1.2005, A6

Figure 9: Map of Finland with main road network. (Maanmittauslaitos, karttapaikka)[142]

Figure 10: Helsinki capital region with main land transport networks. (Maanmittauslaitos, karttapaikka)[143]

[142] Maanmittauslaitos, karttapaikka. Available: https://asiointi.maanmittauslaitos.fi/karttapaikka/
[143] Maanmittauslaitos, karttapaikka. Available: https://asiointi.maanmittauslaitos.fi/karttapaikka/

In the centre of Helsinki the sea rose to Kauppatori and in eastern Helsinki into the cellars and garages of private houses.[144] Floods forced their way into dozens of houses in Helsinki. In Kauppatori water was pumped from the sewer network to the sea so that its flow to the cellars could be prevented. In the port of Sörnäinen in Helsinki, about 400-500 imported new cars were damaged by floodwater when the sand wall protecting them broke down during the night. The wharf of the ferry to Suomenlinna was submerged as was Kompassitori in Kaivopuisto.[145] Suomenlinna island was isolated because the ferry could not carry passengers from the submerged wharf.[146] The maintenance tunnel to Suomenlinna was blocked with sandbags from the mainland side already on Saturday to prevent seawater from flooding it.[147]

According to the City of Helsinki Rescue Department the massive paper bales proved to be necessary in preventing the flood peak, even though they did not totally prevent the sea water from rising to Kauppatori.[148] According to fire chief Markku Lehmuskallio from the Helsinki Rescue Department, the paper bales made from newspapers were best in absorbing the water. Bales made from milk cartons or other such material were not so effective. The rescue department got the massive paper bales from Paperinkeräys Oy in Helsinki. According to Lehmuskallio it would be good to have the paper bales in stock in case of future floods.[149]

During the night the rescue department had altogether 80 rescue and flood prevention assignments in Helsinki. The rescue department was still pumping the rainwater drains during Sunday afternoon near Kauppatori. The worst situation was in Marjaniemi, where the floodwater entered cellars and garages and surrounded many of the private houses by the morning. As the sea level rose most of the snow melted, which caused further flooding in ditches.[150]

The police estimated that traffic in the centre of Helsinki would become normal by Monday morning. Kauppatori was able to continue business as usual by Monday. Helsinki Water asked for special attention from members of the public, especially in underground car parks as well as in those buildings where there are many floors below street level. The pumping of floodwater from the sewers was to go on for days. It was also possible but not likely that water would get into the metro tunnels.[151]

In Virolahti, on the coast of the Gulf of Finland, elderly people were evacuated from two terraces of houses and there were other evacuations in Pyhtää. Altogether some twenty people were evacuated. In Porvoo the water rose to the lower parts of the buildings along the shore. Residents

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[144] *Myrsky ei aiheuttanut pahoja tuhoja Suomessa.* MTV3.fi 9.1.2005. Available: http://www.mtv3.fi/uutiset/arkisto.shtml/arkistot/kotimaa/2005/01/341243
[145] *Suomenlahti tulvi äkäisesti kaduille ja taloihin.* Helsingin Sanomat 10.1.2005, A6
[146] *Myrsky ei aiheuttanut pahoja tuhoja Suomessa.* MTV3.fi 9.1.2005. Available: http://www.mtv3.fi/uutiset/arkisto.shtml/arkistot/kotimaa/2005/01/341243
[147] *Tulva katkaisi Suomenlinnan lauttaliikenteen.* Helsingin Sanomat 10.1.2005, A7.
[148] *Myrsky ei aiheuttanut pahoja tuhoja Suomessa.* MTV3.fi 9.1.2005. Available: http://www.mtv3.fi/uutiset/arkisto.shtml/arkistot/kotimaa/2005/01/341243
[149] *Tulvavalleille ei ole tarvetta Loviisan voimalassa.* Aamulehti 10.1.2005, A5
[150] *Myrsky ei aiheuttanut pahoja tuhoja Suomessa.* MTV3.fi 9.1.2005. Available: http://www.mtv3.fi/uutiset/arkisto.shtml/arkistot/kotimaa/2005/01/341243
[151] *Helsingin ydinkeskustan liikenne ennallaan ehkä jo aamulla.* Helsingin Sanomat 10.1.2005, A7

from the houses near the railway station were carried by boat to the nearby road.[152] A confirmation camp was evacuated from the Pelling island of Porvoo.[153] Also, in Tammisaari, Loviisa and other east coast cities of the Gulf of Finland, sea flooded buildings along the shore. The rescue department pumped water from buildings in different parts of Uusimaa region until late Sunday afternoon.[154] Some streets were closed off in Espoo, Kotka, Kirkkonummi, Sipoo, Raisio and Porvoo.[155]

The worst problems caused by the flood happened in Turku, where the whole passenger port of Turku was under water on Sunday morning. Passengers went to and from the ships on temporary bridges and even loader buckets.[156] At the Hotel Seaport in Turku residents were evacuated to higher floors when the flood reached the hotel's entrance hall.[157]

In St Petersburg, Russia, the Emergency Ministry EMERCOM did not expect the storm to accelerate, but warned of strong winds. The water level in the river Neva was expected to rise 1.6 – 1.8 meters above average during Sunday morning and for that reason the rescue services were on full evacuation alert, which would be materialized if the flood would be 2.0 m above the normal water level. In Kaliningrad there was a warning of wind gusts of 28 m/s and small ships were urged to come ashore.[158] The Road E18 was closed to traffic during Sunday afternoon in Viipuri, and Vaalimaa frontier stations were closed. Water rose over the E18 from Vaalimaa to Viipuri.[159] In St Petersburg, the river Neva was 2.4 m above average. According to the authorities, large-scale damage was avoided.[160] Six metro stations were closed because of the flood risk. In Kaliningrad the storm wind caused much damage to roofs and power lines.[161]

In Estonia, the worst flood situation was in Pärnu. The sea surrounded the area on shore where most of the spa hotels were located. More than 200 tourists were evacuated in Pärnu region.[162] Many of the tourists were Finnish retirees. Also an elderly people's home, school, kindergarten and psychiatric hospital were surrounded by water. The sea level was 3.0 m above average at its highest in Pärnu. By Sunday night in the Pärnu region there were 11 civilians who had been taken to hospital because of hypothermia. The City of Pärnu estimated that the city would run out of drinking water before 9 pm on Sunday night. The sea level also rose in the city of Haapsalu. During Sunday around 60 people were evacuated there. On Sunday night about 15 per cent of Estonian houses were without electricity.[163] The fire departments and Estonian army evacuated the people from the

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[152] *Suomenlahti tulvi äkäisesti kaduille ja taloihin.* Helsingin Sanomat 10.1.2005, A6
[153] *Rippileiri evakuoitiin Porvoon saaristosta.* Helsingin Sanomat 10.1.2005, A7
[154] *Myrsky ei aiheuttanut pahoja tuhoja Suomessa.* MTV3.fi 9.1.2005. Available: http://www.mtv3.fi/uutiset/arkisto.shtml/arkistot/kotimaa/2005/01/341243
[155] *Myrskyn nostama vesi tulvi teille ja kellareihin.* YLE24 10.1.2005. Available: http://www.yle.fi/uutiset/haku.php?action=page&id=178221&search=tulv*
[156] *Itämeren myrsky nosti Suomenlahden pinnan ennätyskorkeuteen.* Helsingin Sanomat 10.1.2005, A3.
[157] *Myrskyn nostama vesi tulvi teille ja kellareihin.* YLE24 10.1.2005. Available: http://www.yle.fi/uutiset/haku.php?action=page&id=178221&search=tulv*
[158] *Pietarissa varauduttiin Nevan pinnan nousuun.* Helsingin Sanomat 9.1.2005, A6
[159] *Tulva sulki tien Vaalimaalta Viipuriin.* Helsingin Sanomat 10.1.2005, A7
[160] *Itämeren myrsky nosti Suomenlahden pinnan ennätyskorkeuteen.* Helsingin Sanomat 10.1.2005, A3.
[161] *Nevan pinta nousi Pietarissa yli kaksi metriä.* Helsingin Sanomat 10.1.2005, A7
[162] *Itämeren myrsky nosti Suomenlahden pinnan ennätyskorkeuteen.* Helsingin Sanomat 10.1.2005, A3.
[163] *Kylpylävieraita evakuoitiin veneillä Pärnussa.* Helsingin Sanomat 10.1.2005, A7

flooded areas. The defence forces provided vehicles and boats for evacuation.[164] The ferry connection from the mainland to Saaremaa Island was cut because the wharfs at both ends were underwater.

There were also electricity blackouts. According to estimates, it took at least three weeks to repair the flood damage to the hotels in Saaremaa.[165] The Ministry of Foreign Affairs informed the Rescue Service Unit about the situation in Pärnu, Estonia as well as in St Petersburg, Russia. People had been evacuated and one helicopter was in use in Pärnu. The situation seemed to be under control. Still the RSU prepared for the case by organising that the Finnish Border Guard would be able to loan one of its Agusta Bell 412 helicopters to Estonia, if requested.[166]

It was a surprise to some people that not all insurances cover damage caused by flooding. Helsingin Sanomat met family Stenberg whose basement had been flooding. Ms. Stenberg said that the family might be facing an "economic disaster", since their insurance would not cover expenses. On 11 January representative of Ministry of the Interior estimated that flooding would have caused damage worth "millions" of euros.[167]

According to the estimates, the storm caused 20 million euros in costs to the insurance company Sampo alone. Sampo estimates that in Finland its customers suffered damage worth 7 million euros. Bigger loses came in Sweden, where the loss was about 11-17 million euros.[168]

As often in a large scale disaster, the private and public sector had different policies for the compensation of the flood damage. Some of the insurance companies were not willing to cover the flood damage at all, and some of them considered the flooding caused by the storm an exception that they would cover.

The insurance company *If* covered flood damage caused by storms in their home insurance, but in the real property insurance flood damage were not covered at all. The insurance companies *Fennia* and *Pohjola* were willing to cover the flood damage in both their types of insurance.[169] In Finland, flood damage is usually covered by the state, but in case of a flood caused by a storm, broad home insurance policies are expected to cover most of the damage. The Counsellor for Water Administration at the Ministry of Agriculture and Forestry, Jaakko Sierla, pointed out that in this case it was the storm that caused the sea level rise and which led to the flooding. Damages are covered by insurance if the term "storm" is mentioned in the insurance conditions[170] . Prime Minister Matti Vanhanen made an early promise on Monday 10th Jan that the state would cover the damage that

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[164] *Suomalaisten loma keskeytyi, Viron armeija haki veneillä pois.* Aamulehti 10.1.2005, A5
[165] *Suomalaisten loma keskeytyi, Viron armeija haki veneillä pois.* Aamulehti 10.1.2005, A5
[166] Duty record of the Rescue Service Unit of the Ministry of the Interior
[167] Helsingin Sanomat 11.1.2005 (retrieved from newspaper's archive. Available at: http://www.hs.fi/paivanlehti/arkisto/Vakuutus+ei+v%C3%A4ltt%C3%A4m%C3%A4tt%C3%A4+korvaa+tulvan+aiheuttamia+vahinkoja/aaHS20050111SI1YO02vmh?src=haku&ref=hs-navi-paivanlehti)

[168] *Sammolle yli 20 miljoonan vahingot.* Aamulehti 12.1.2005, etusivu
[169] *Vakuutus ei välttämättä korvaa tulvan aiheuttamia vahinkoja.* Helsingin Sanomat 11.1.2005, A7
[170] *Vakuutukset korvaavat, kun tulva johtuu myrskystä.* Aamulehti 11.1.2005, A5

the insurance companies would not. This was a far greater promise than was made by his Estonian colleague Juhan Parts, who promised that the state would cover some of the damage.

The prevailing practice is that the insurance companies do not cover any flood damage. According to Jaakko Sierla, this is logical since large floods are rare and usually very localised. In the insurance sold to large groups, it would be difficult to consider also the special needs of some particular flood risk area. Since the 1980s about 800,000-900,000 euros annually has been alocated to cover flood damage by the state. The only exception was in 2004, when there were large floods in Ostrobothnia. The insurance companies have stated that they are in the process of developing better insurance policies to cover natural disasters.[171]

The flood damaged not only private property but also sewerage systems and harbour equipment. Some road foundations also collapsed. According to Preparedness Director Janne Koivukoski at the Ministry of Interior, it was hard to estimate the total costs, but altogether the flood caused damage of millions of euros. The damage was only material. In neighbouring countries the floods and storm claimed lives, but fortunately in Finland no one died.[172]

Nuclear Power Plant

The nuclear power plant in Loviisa announced to the Radiation and Nuclear Safety Authority (STUK) that it was on alert because of the sea level rise.[173] At 09:00 on 08 January it gave the same announcement to the Rescue Service Unit of the Ministry of Interior.[174] In the morning the sea level was 171 cm above normal and the Energy Company Fortum was preparing to close down the power plant if the sea level continued to rise. A 2m rise is the critical point after which the power plant needs to be secured and closed. Fortunately, the sea level started to drop on the afternoon of Sunday 09 January.[175] The situation was monitored closely by STUK and the staff of the nuclear power plant.[176]

Closing down the nuclear power plant would have affected the distribution of electricity. There was a representative of STUK based in Loviisa and the STUK was prepared to establish a command centre there. STUK was responsible for communications, as is stated in the communications plan.[177] The Rescue Service Unit of the Ministry of Interior informed the State Province Office of Southern Finland about the situation. The situation was also briefed to the Minister of the Interior, Kari Rajamäki, State Secretary Risto Volanen and to other key officials. The alert in Loviisa was later cancelled (14:31).[178] Closing down a nuclear plant takes a few hours, depending on whether only the power

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[171] *Vakuutukset korvaavat, kun tulva johtuu myrskystä.* Aamulehti 11.1.2005, A5
[172] *Vakuutus ei välttämättä korvaa tulvan aiheuttamia vahinkoja.* Helsingin Sanomat 11.1.2005, A7.
[173] *Loviisan ydinvoimala varautuu tulvaan.* Säteilyturvakeskus 9.1.2005. Available: http://www.stuk.fi/stuk/tiedotteet/fi_FI/news_355/
[174] Duty record of the Rescue Service Unit of the Ministry of the Interior
[175] Duty record of the Rescue Service Unit of the Ministry of the Interior
[176] *Loviisan ydinvoimala varautuu tulvaan.* Säteilyturvakeskus 9.1.2005. Available: http://www.stuk.fi/stuk/tiedotteet/fi_FI/news_355/
[177] Duty record of the Rescue Service Unit of the Ministry of the Interior
[178] Duty record of the Rescue Service Unit of the Ministry of the Interior

should be wound out or if the reactor itself is closed. The sea level has never been so high in Loviisa before. It was unusual that although the sea level was rising, there were only a few high waves near Loviisa. The earlier record height was 1.6 metres. At the other nuclear power plant site in Olkiluoto there was no need for special measures. The sea level rose only 0.8 m and the danger limit is 2.3 m, according to Reijo Sundell, production manager of Olkiluoto nuclear power plant.[179]

During Sunday 09 January STUK was in contact on several occasions with the nuclear power plant in Sosnovyi Bor, in Russia. The nuclear power plant increased its preparedness for closing the power plant down if the rising sea level were to risk its safe functioning.[180] According to information received from the Russian authorities, the sea level rise was estimated to be 240 cm above the average. This was still significantly under the risk limit of 325 cm in Sosnovyi Bor. Since then, safety cooperation between the STUK and the Sosnovyi Bor has focused on building an estimation system for water level in Sosnovyi Bor that is linked to the Finnish forecasting network.[181]

Helsingin Sanomat had stated a day after the storm that there had been an emergency situation in Loviisa nuclear power plant because of the rise in sea level. Loviisa power plant is situated on the island of Hästholm, 90 kilometres East from capital Helsinki.

Loviisa nuclear power plant monitored the rise in sea level and was about to start to prepare to shut down the reactor. According to the security code of conduct, preparation is started if the sea level rises over 1.75 metres. At worst, it was at 1.73 m – only 2 centimetres off the threshold. Loviisa nuclear power plant informed Finnish Radiation and Nuclear Authority STUK first on the morning of 09 December. At 04:35 the sea level was +1.4 m, and this was considered to be an “unusual situation”. At 07:39, the sea level was at +1:6 m, which was already a reason for preparations to run down the reactor.[182]

Later, a representative of STUK said in an interview with Taloussanomat, that + 3.0 metres is a level, when actual damage could occur, but +1:75 meters is considered to be a hazard scenario and leads to running down the nuclear reactor.[183]

Exercise “Loviisa 13”

Based on the law on civil protection (3.5.2011/406) the Nuclear Power plants will be testing their capacities every third year. The latest exercise was organized on 14 March 2013. It was conducted

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[179] *Tulvavalleille ei ole tarvetta Loviisan voimalassa.* Aamulehti 10.1.2005, A5
[180] *Säteilyturvakeskus oli yhteydessä Sosnovyi Boriin.* Helsingin Sanomat 19.1.2005, A5
[181] *Säteilyturvakeskus oli yhteydessä Sosnovyi Boriin.* Helsingin Sanomat 19.1.2005, A5
[182] Ydinturvallisuus. Suomi ja lähialueet. Neljännesvuosiraportti 1/2005. (Radiation and Nuclear Safety Authority STUK quartal report on nuclear safety in Finland and its neighbourhood 1/2005.). Available: http://www.stuk.fi/ydinvoimalaitokset/nvr/nvr1-2005.html

[183] Taloussanomat 29.3.2011. Available at: http://www.taloussanomat.fi/energia/2011/03/29/tulva-voi-pysayttaa-ydinvoimalan-suomessa/20114336/12

jointly among key national and local civil protection actors and led by the Itä-Uusimaa Rescue Service.[184]

The exercise focused on preparatory measures and inter-agency prevention. Special attention was paid to start-up measures, building up coherent situational picture and maintenance, assessment methods, inter-agency and private-public communications and juridical and administrative challenges of crisis management.

The exercise in 2013 included a desk-study and a live exercise. The desk-study phase tested the rescue plan produced by Itä-Uusimaa Rescue Service to respond to a serious radiology threat caused by Loviisa Nuclear Power Plant. The live exercise focused on operational interaction between service provider Fortum Corporation, Itä-Uusimaa Rescue Service, Kymenlaakso Rescue Service, hospitals, Border Guard and Defence Forces. Special emphasis was laid on evaluation and on-site monitoring.

In general, as also in the "Loviisa 13" exercise, the overall evaluation was positive and only pointed out a few obstacles and areas which needed further testing and development. All too often these types of exercise are designed, conducted and even evaluated by those who are practicing them. There is no space for real challenge and "external expertise" which would put the system on its limits and by doing this highlight shortcomings and gaps.

There are multiple supportive situational surveillance processes in place. For example, the Finnish Radiology and Nuclear Safety Authority (STUK) have a new situation and threat system called TIUKU, the civil protection authorities use the PEL-JOKE system and the Finnish Meteorological Institute (FMI) uses the LUOVA system to warn of natural hazards and disasters.

[184] Loviisan voimalaitoksen pelastustoimintaharjoitus "Loviisa 13", 14.3.2013, Report on the exercise.

B. Storm "ASTA" 2010

Description of the Meteorological Event

A phase of hazardous storms began at the end of July 2010. All storms occurring during this timeframe were linked to the same weather pattern. From early July to mid-August, Finland had exceptionally warm temperatures causing these phenomena. At the end of July the Finnish Meteorological Institute reported some alarming weather conditions and record high temperatures.[185]

The storm Asta hit Finland on the night of 30 July 2010 at 02:00 am. Asta (30 July) was followed by Veera storm (04 August), Lahja storm (07 August) and Sylvi storm (08 August). These severe storms impacted the same regions for 11 days, multiplying their costs/effects. This weather phenomenon was characterized by high winds, rain and sometimes hail as well as thunderstorms.

In this section the special emphasis is on the Asta storm which was a typical thunderstorm with downward flows. Its strength and amount of blizzards (24,415) made it exceptional. Especially its occurrence overnight with downward flows made it rare – but fortunately there were no human loses. Asta proceeded with a 100 km wide storm front and it affected the Finnish territory for 4.5 hours. The approximate speed was 102 km/h and the highest measured wind was 29 m/s. It affected five regions: South Savo, Southern Karelia, Northern Karelia, North Savo and Central Finland. The economic losses of this storm surge was biggest for the forestry (30,000 km2) and in financial terms 50.4 million euro (refunded by insurers). The electricity network was badly damaged affecting 1/3 of electricity providers in Finland (480,000 clients and leaving 100,000 of them longer than 12 hours without electricity). The longest interruptions experienced in permanent residences in rural areas were up to a month and even longer in holiday houses.

This section focuses on the effects of the Asta storm in the South Savo Region which has 155,000 inhabitants and the administrative centre is Mikkeli (see Figure 6). The regional structure is heterogeneous and built on three major cities Mikkeli, Savonlinna and Pieksämäki. A special characteristic is the large amount of lakes – one quarter of the territory is covered in water (almost 40% of the territory in some municipalities).[186] Agriculture and forestry are the largest employers and economic sectors in this region.

[185] Onnettomuustutkintakeskus. Heinä-elokuun 2010 rajuilmat. S2/2010Y. 7. Available: http://www.onnettomuustutkinta.fi/en/index/tutkintaselostukset/muutonnettomuudet/tutkintaselostuksetvuosittain/muutonnettomuudet2010/s22010yheina-elokuun2010rajuilmat.html

[186] SPEK, Rajuilman vaikutukset paikallisten yritysten liiketoimintaan 2012, p. 7.

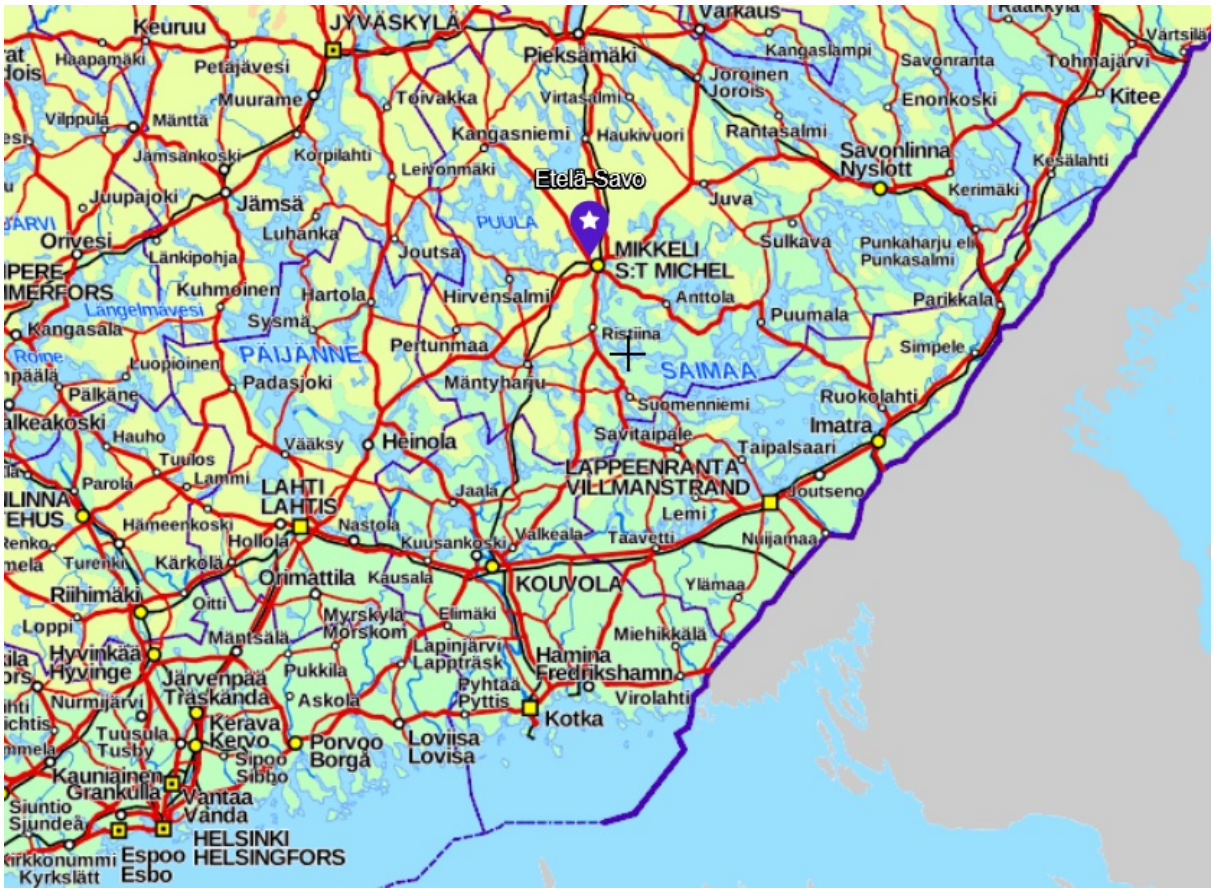

Figure 11: South-Savo region with main land transport networks. (Maanmittauslaitos, karttapaikka)

Situational awareness

The first symptoms arrived on 29 July 2010 when the storm arrived from Karelia towards Finland. Before midnight the storm reached the Finnish eastern border. It was proceeding with a 100 km wide range and its first implications were felt at 00:20 am at Sulkava municipality. The storm destroyed vast amounts of forest in Sulkava, Rantasalmi, Kitee and Joroinen. In Sulkava only, there were tens of thousands of trees destroyed. These blocked roads, caused material damage to houses and vehicles, disrupted the water and sanitation systems and scaled down the electricity grid.

The first responder was the South Savo Rescue Region (Department) which also served as a central command unit in the Asta storm. It received 210 emergency missions.

The storm arrived so quickly that only a few dozen seconds were available to react or seek cover. Based on Accident Prevent Authority report, on the basis of weather alerts, both citizens and the first responders had difficulties in formulating what these storms meant in practise. It is not possible to forecast the precise areas affected by such downbursts.[187] During the storms, the rescue

[187] Onnettomuustutkintakeskus, Heinä-elokuun 2010 rajuilmat. S2/2010Y. 7. Available: http://www.onnettomuustutkinta.fi/fi/index/tutkintaselostukset/muutonnettomuudet/tutkintaselostuksetvuosittain/muutonnettomuudet2010/s22010yheina-elokuun2010rajuilmat.html

departments were unable to maintain a situational picture which could serve various authorities and other actors.

In order to maintain the situational awareness, the Savonlinna rescue station served as a basis for the TOJE (Sectoral command centre). From the South Savo Rescue Department the information was sent to Regional Administrative Agency of Eastern Finland (AVI Eastern Finland). From AVI Eastern Finland the information was channelled to the Situation Centre of the Ministry of the Interior. From the Ministry it was further sent to Government Council Situation Centre.

It is notable that South Savo Rescue Department later noted that they did not receive any kind of coherent and centralized situational picture from the national level. However, the Finnish Meteorological Agency (FMI) did send early warning signals. The South Savo Rescue Department was able to map the risk area only after the exact radar picture was received.

First warning of the weather conditions was sent to authorities 30 hours in advance of the Asta storm. The Finnish Meteorological Institute gave an early warning on 29 July about “very strong thunderstorms” in four separate announcements. The warning included a special remark about heavy rains in those areas where the rain water would exceed 30 mm in an hour. The FMI weather forecast warning included elements of thunderstorms and heavy winds.

The South-Savo Rescue Service in Savonlinna noted 396 rescue missions on 30 July. On the next day the amount had decreased to 34. Altogether there were 692 dispatch calls to South-Savo over the 10 day duration.

Building up situational awareness was difficult as most of the helicopters were booked to the Jyväskylä Neste Oil Rally. The first flight was done on 30 July at 06:00 am.

The regional rescue departments felt that there should have been a more systematic mechanism to provide situational data to field units and regional rescue operators. This should include both the national level data and the weather data from the FMI. The situational awareness should be two-way and comprehensive. The sectoral thinking should be abandoned in order to achieve better inter-sector and inter-agency cooperation.

Management and Emergency

Whereas the national level response was not needed and the essential authorities declared that the situational awareness had been sufficient, the local and municipal level authorities faced difficulties to obtain timely and coherent data. Challenges emerged of sharing capacities and data across the borders of the regional rescue services. Also there was no request of mobilizing the Finnish Rescue Force (highly equipped Finnish rescue commando battalion) or the first assistance units of rescue services (*Pelastuslaitosten virka-apukomppania*) to provide assistance to the worst hit regions.

Referring to the Safety Investigation Authority the municipalities´ management groups convened only in rare cases even in the worst storm damage areas. This demonstrated better-than-average readiness for the management of storm disturbances in those municipalities which had agreed to collaborate with the rescue department in alerting their management groups. Such municipalities

were also better prepared through the management capabilities of their key people and other management support activities during disruptions.[188]

Municipalities have highlighted the need for information from electricity companies and rescue departments in particular. They also emphasised the need for continuous cooperation with the private sector (such as nursing facilities).

The role of citizens in this particular storm case should be further evaluated in terms of producing situational data for the authorities. This is particularly needed in rural areas spread over long distances. The latest IT and mobile applications should be available, and the focus should be on mobile phone applications producing live and photo data.

Management of emergency

Finland has only rarely been affected by severe weather phenomena. Referring to the Accident Prevention Authority report (S2/2010Y) on storms of July-August 2010 this largely explains why essential emergency response actors did not have operating models in place enabling them to fully react to early warning signals. It also explains why measures were only taken in the wake of the damage caused by the Asta storm.[189]

The first response was conducted by the South Savo Rescue Department. Decisions concerned what kind of land transport networks would be prioritized to secure the logistics and vital functions of society. Destia is a Finnish infrastructure and construction service company which used to be publicly owned operator. During the Asta storm, Destia provided information about the damages to land transport networks. The emphasis was to secure those roads which had asphalt pavement coverage.

The amount of emergency calls was so high that the South Savo Rescue Department was forced to encourage the citizens to take some measures on their own.

The response measures lasted weeks. Several trains were replaced by buses and many roads were cut off with falling trees and other interruptions

Local and municipal level

The geographical area where the Asta storm took place is wide and demanding due to large lake areas. July-August is the most active period because of the holiday season and results in an increased population in Eastern Finland. Most of the holidaymakers were familiar with rapid reaction by emergency authorities due to living in a metropolitan area. However, in remote areas of Eastern Finland the first responders might arrive after one hour or so. Difficulties emerged as the electricity was down which resulted to bad communications between citizens and the rescue authorities.

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[188] Onnettomuustutkintakeskus. Heinä-elokuun 2010 rajuilmat. S2/2010Y, p. 8. Available at: http://www.onnettomuustutkinta.fi/fi/index/tutkintaselostukset/muutonnettomuudet/tutkintaselostuksetvuosittain/muutonnettomuudet2010/s22010yheina-elokuun2010rajuilmat.html

[189] Onnettomuustutkintakeskus. Heinä-elokuun 2010 rajuilmat. S2/2010Y, p. 7. Available at: http://www.onnettomuustutkinta.fi/fi/index/tutkintaselostukset/muutonnettomuudet/tutkintaselostuksetvuosittain/muutonnettomuudet2010/s22010yheina-elokuun2010rajuilmat.html

In Finland the rescue services have gone through a wide transformation process in the "Regionalization of Finnish Rescue Services". In the regionalisation process the previous system of rescue services run by individual municipalities (there were over 400) was changed into a regional system comprising 22 regional organizations. The reform aimed to make more effective use of the resources and improve quality and availability of the services. The previous rescue services system had several weaknesses, which were mainly due to the fact that many municipalities were so small and there were too few civil servants. The financial limitations of small rescue service units were severe, e.g. purchase of a fire-engine could only be done once every 20 years. There was duplication of work in administrative affairs. There were no possibilities for staff to specialize. Furthermore, there was not enough cooperation at administrative level and limited personnel resources. Cooperation between the municipalities did take place mainly in operations, but not really at administrative level. In addition, the level of rescue services varied significantly between municipalities.[190]

Although there were already clear cost-benefits for the regionalisation of the rescue services, there are still essential differences in the "materialisation" of the benefits of the new system. For instance, the current situation seems to vary when comparing the situation in the large urban centres of Southern Finland to Northern Finland where distances are longer and rescue capacities weaker. It comes as no surprise that the "winners" of the regionalisation have been described by the interviewed experts as being smaller municipalities and cities. The "losers" have been described to be larger urban centres and cities which are obligated to allocate their resources to wider areas. Also the various interests of the municipalities included in the same rescue regions might diversify and complicate the allocation of resources and long term planning within a single rescue region.

As indicated in the Eurobaltic case study report *"Regionalization of Finnish Rescue Services"* by Anna Halonen and Timo Hellenberg (Eurobaltic Project, 2006), the rescue leaders among the new rescue regions tend to underline that there should be comprehensive and up-to-date situation analysis at the government level. The RAIN project interviews at the Helsinki City Rescue Department and at the East Uusimaa Rescue Region have enhanced this prevailing hypothesis. This could be a joint situation and monitoring system based on multi-agency cooperation instead of the central role for the Ministry of the Interior. The indicators could be distributed among the country in order to get comprehensive situation analysis. The rescue regions should be able to receive risk information from the government council and to provide information seen as necessary.

Referring to the Safety Investigation Authority´s report on the storms July-August 2010 the rescue service operations showed insufficient practical readiness for the management of situations with far-reaching effects. The report also highlights that rescue departments and their contract fire brigades

[190] See: A. Halonen & T. Hellenberg. 2006. Eurobaltic case study report: *"Regionalization of the Finnish Rescue Services".* Available at: http://www.helsinki.fi/aleksanteri/civpro/publications/eurobaltic_case_study_regionalisation_of_finnish_rescue_services.pdf

carried out substantial tree clearance work which is not included in rescue operations defined under the Rescue Act.[191]

National and governmental level

The Ministry of the Interior soon announced that there is no need for national rescue measures and the Ministry does not see it necessary to take a national coordination role due to the storm. The Ministry noted that the regional rescue services had informed about the developments and they had performed well. Director-General Pentti Partanen noted that the Finnish Meteorological Institute has provided timely and concrete weather forecasting which helped the authorities to prepare for the rescue measures. He noted also that the electric power companies and rescue service regions were able to respond more timely based on this weather forecasting. Critical comments soon emerged from several Rescue Departments due the incoherent situational picture.

Consequence management

Administration

The power utility companies expressed their wish that the risk resilience of the current electricity network should be improved which would mean increasing electricity power stations and automatic system of network service. Moreover, underground cabling of the distribution network was sought.

Whereas the regional rescue services were more reserved and rather critical about the support received from other regions and the national level, the Regional State Administrative Agencies (AVI) were positive about their assessment. For example, the AVI Eastern Finland expressed their gratitude to multiple spheres of society for their cooperation.

The most critical comments came from municipal level authorities. They made a point of focusing on weak preparedness, incoherent situational awareness and poor reactivity which they blamed on a number of individuals and authorities. Improvisation was essential for success instead of relying on consequence management based on a systematic approach.

Material damage

The total costs have been estimated to be over 32 million euros (standard compensations 10 million, operational costs 18 million and investments 4 million).

The biggest economic losses occurred **in forestry** during summer of 2010. According to the Finnish Forest Research Institute Metla, a total of 8.1 million m3 of standing timber fell or was destroyed.[192] This equates to 15 percent of the annual cutting amount. The direct losses to forestry resulted by July-August storm season have been estimated as 240,000 hectares of land. One tenth (24,000

[191] Onnettomuustutkintakeskus, Heinä-elokuun 2010 rajuilmat. S2/2010Y. p. 8. Available at: http://www.onnettomuustutkinta.fi/fi/index/tutkintaselostukset/muutonnettomuudet/tutkintaselostuksetvuosittain/muutonnettomuudet2010/s22010yheina-elokuun2010rajuilmat.html

[192] Onnettomuustutkintakeskus, Heinä-elokuun 2010 rajuilmat. S2/2010Y, p. 7. Available at: http://www.onnettomuustutkinta.fi/fi/index/tutkintaselostukset/muutonnettomuudet/tutkintaselostuksetvuosittain/muutonnettomuudet2010/s22010yheina-elokuun2010rajuilmat.html

hectares) was totally destroyed. The most severe material damage was caused by exceptionally strong downbursts. These occurred mainly during night time.

Referring to the Accident Prevention Authority, because of forest damage, **electric power networks** (including distribution networks) were destroyed in the storm impact areas.[193] The electric grid and distribution networks were largely affected in Eastern and Central Finland. A total of 35,000 kilometres of electric power network were destroyed or damaged. As a result, some 9,000 distribution sub-networks were left without electricity. Power cuts and their consequences were more widespread than in the immediate storm areas.

They affected one third of the service providers and about 480,000 electricity customers. Almost 100,000 of them were longer than 12 hours without electricity. The Asta storm caused interruptions to electricity distribution due the falling trees on main electric network. In South Savo electrics were down from 23,000 households and in Eastern Finland approximately 40,000 households were without electricity.

The wide extent of damage and repair needs led to rather long power cuts. Electric power failures hit also archipelago in big lakes like the Saimaa Lake. The longest period of time without electricity was six weeks.

The long power cuts led to significant disturbance to other functions vital to society, such as communications networks, water supply and transport infrastructure.[194]

Mobile phone networks were cut off in large areas. The mobile link stations went down as reserve power units were used. There were 1050 GSM and UMTS mobile phone support units down. The mobile phone operators tried to provide extra power for support units by using aggregates. Elisa mobile phone operator stated that the phone connections were down on 100 km wide range. Most of the Elisa clients suffered were in the north of the Imatra, Mikkeli, Jyväskylä and Karstula. The other tele-operator Sonera reported that most of the interruptions were in the area between Savonlinna, Varkaus and Viitasaari. The third tele-operator, DNA, reported that largest disruptions were measured in the Savonlinna region. Most crucial support units were placed with portable aggregates. Elisa operator reported that 30,000 clients were suffering from bad connections only in the South Savo region.

Soon after the pumps in water towers stopped working and authorities gave order to avoid using water in Joroinen, Sulkava, Rantasalmi, Kerimäki, Enonkoski and Juva.

Social and human losses

The storms of July-August 2010 caused directly one death and several dozens injured persons. Most of the human injuries were caused by flying objects, falling trees and slippery conditions. Some persons were hurt while clearing wood from roads and pushing through blocked roads.

[193] Ibid.
[194] Ibid.

Cascading effects

Major cascading effects were caused by falling trees and destroyed forestry. When strong winds were cutting trees they took electricity cables with them. This caused wide black outs in multiple regions. Another challenge was caused by roads which were cut down by flying trees and other materials such as roofs. Rail roads were mostly working normally.

C. Hypothetical Scenario

Preventive civil protection measures are aimed at maintaining the operation of societal services and preventing the situation getting worse resulting in an uncontrollable disaster. In Europe we have built generally well-functioning systems for prevention and mitigation of natural and man-made disasters if they occur on a specific geographical and functional area, e.g. fire-fighting in the Finnish conditions. Focus has usually been directed towards known circumstances that can cause a disaster as well as prevent emergency services from providing assistance to the event. Significant problems can occur if we have a surprising situation with multifaceted conditions and accumulative effects of disasters on the technical and societal infrastructure.

It is important for the development of the organisation of emergency administration and disaster management to shape scenarios which include surprising elements as well as complex and dangerous situations. These could be possible but not necessarily very probable. The purpose of analysing a hypothetical worst-case scenario is to identify and localise the "breaking" points, to enhance understanding of the nature of severe crises, and to find out where the preventive measures can fail or are missing.

Simulation of a hypothetical worst case scenario should not be considered as an expression of suspicions towards the capability of the prevailing civil security system. Its purpose is not to point out specific deficiencies of the personnel and technology but to show the situations where civil security and infrastructure protection systems can be overwhelmed due to exceptionally difficult circumstances.

Simulated Scenario

In order to test the resilience of societal infrastructure in extreme weather conditions, a scenario was created and evaluated in a study in 2012-2013 specifically concerning the Loviisa nuclear plant in Southern Finland.[195] It was not exactly based on the facts of how nuclear safety protocols in Loviisa are actually organised and handled, but it is rather a general model of the threats and problems in keeping safety and security of technical infrastructure effective also in severe weather conditions. It was concluded during a study that this type of scenario served well as a testing means for civil protection arrangements.[196]

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[195] The scenario was outlined and discussed in a seminar organized by the Finnish Radiation and Nuclear Safety Authority (STUK) in Helsinki September 2012. It was part of the Project European Union Strategy for the Baltic Sea Region, Flagship Project EUSBSR 14.3 Task F: Macroregional Risk Scenarios and Gaps. Available: http://www.14point3.eu/tasks-2/task-f/task-f-general-summary-of-task-implementation-process/ and http://www.cbss.org/strategies/14-3-macro-regional-risk-scenarios-and-gaps-identification/

[196] See report by Juha Rautjärvi, Pekka Visuri and Martti Annanmäki, Study on nuclear safety: identification of the gaps in disaster prevention and coping strategies of the Baltic Sea region countries (Flagship Project EUBSR 14.3 Task F), May 2013.

An extreme weather event resulting which damaged communications over a period of one week Was simulated. In the simulation, the first weather forecasts were issued as follows: a few hours of heavy wind and rain, which was turning to a wet snow, causing severe damage to the environment, especially to the electricity transmission lines, communication infrastructure and roads. Then, the following day the wind direction changed from south-west to north-east. Within a couple of hours, the temperature fell much below zero.

The consequences for the rescue services and infrastructure were fatal: From the very beginning the implementation of the preventive measures and rescue operations would be in great trouble, impaired by lacking communication and information, unable to gain physical access to locations potentially endangered. For the regional rescue services and leadership of the crisis management help of a different kind would be needed soon. Caused by the cumulative effects of bad weather conditions and the failures in the technical infrastructure the nuclear safety measures could not prevent leakage of radiation which turned towards the south. In this phase the disaster should also concern neighbouring countries and demand crisis management measures by the European Union.

To allow a more realistic outcome the weather situation used was simulated based on a winter storm in the Northern Baltic Sea in December 2011. The storms from 26th to 29th of December particularly affected Southern Finland: the electricity grid was disabled in many areas for several days. It resulted in communication problems for cell-phones. Floods occurred simultaneously with low severity frost. It was therefore very important that the most dangerous storm area (gusts circa 35-40 m/s, see Figure 7 remained in sea areas west of Finland. Still, there was a real possibility that the storm could affect the Finnish mainland with heavy gusts. Also, the temperature remained rather warm some days after the storm.

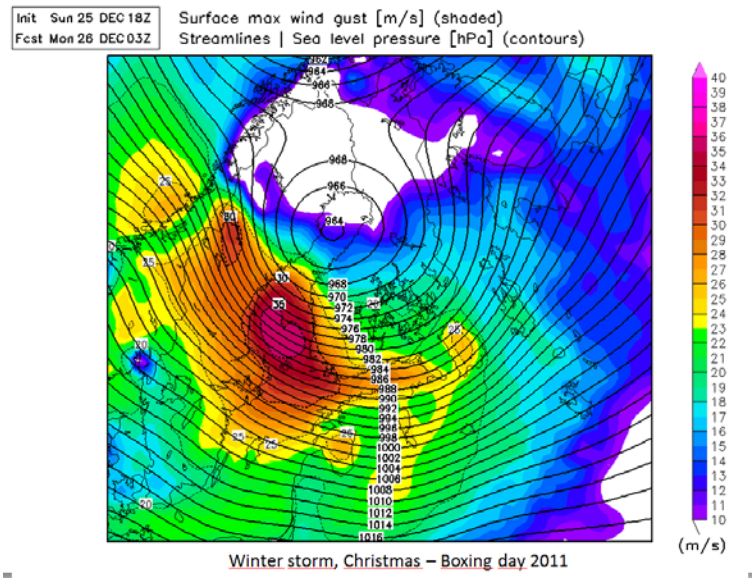

Figure 12: Map on real weather situation 25-26 December 2011 shows that the centre of the storm was between Sweden and Finland in the Gulf of Bothnia. Because it stayed there, the destructions in Finland were rather small.

The scenario: a combination of bad weather and technical failures

For the selected scenario, the following hypothetical weather conditions were considered:

- Timing: 10 January. Extreme winter storm in Finland caused by an extended low-pressure area in the Baltic Sea area. The route of the low-pressure area is from Denmark towards the Kola Peninsula (see Figure 8).
- In southern Finland and in the northern parts of the Gulf of Finland the wind is first south westerly but turns to blow from the west (see Figure 9).
- Wind speed exceeds the design basis of the main power transmission lines (> 39 m/s in three-second gusts).
- High (> +2 m) sea water level in the Gulf of Finland.
- Heavy snow falls (i.e. wet snow, precipitation > 100 mm/day in water).
- Temperature around zero.
- Just after the storm there is no ice in the Gulf of Finland.

It is remarkable that those conditions are not very rare in Finland during December and January. However, it can be assumed that the strength of the winter storm came as a surprise also to the meteorologists. Thus, necessary warnings were not given in due time, which partly explains the severity of the consequences.

Figure 13: Low pressure area with strong storm nears Finland from the southern Baltic Sea. The storm in Finland lasts about one day.

During the following days the wind direction turned to the north, and the temperature began to drop below zero, to -20 degrees Celsius. The high pressure air with frost and weak wind lasted some two weeks in Finland. Sea ice rapidly formed because of decreasing air temperatures.

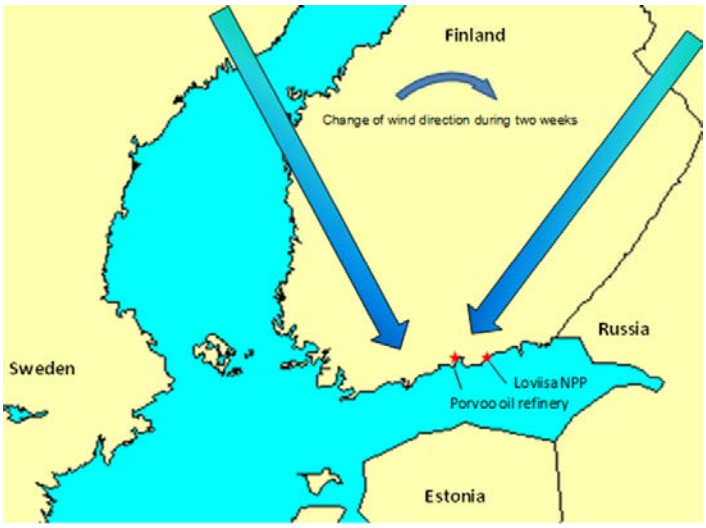

Figure 14: The map shows wind directions after the initial storm and Loviisa nuclear power plant as well as the oil refinery in Porvoo.

The initial storm from the Baltic Sea caused electrical blackouts in southern Finland, and also extensive blockage of roads. The National transmission power grid was damaged in many places. Bad weather conditions over several days made the rescue operations difficult. In the coastal forest areas cell phones were mostly out of service and many roads were blocked. Loss of heating capacity of dwellings and other buildings demanded rapid measures to be taken by the local administration and rescue services. There was also dispersion of oil releases in the sea. A minor release occurred due to the fire at the Porvoo oil refinery and a major one was caused by the collision of an oil tanker and a cargo ship some 30 km from the Loviisa nuclear power plant.

At Loviisa nuclear power plant a long-term loss of off-site power took place. The fuel was damaged in one of the units after four days of the loss of external power. Radioactive material was released (one day's release) into the sea and to outdoor air soon after the fuel degradation. Radioactive materials firstly moved in the air towards Russia and eastern Estonia and later on towards the southern Baltic Sea Region. The amount of the released material into the air and its radionuclide composition was approximately the same as in the Fukushima accident. The concentrations of radioactive materials in the sea water are approximately the same as reported in the Fukushima accident.[197]

The underlying idea of the reference scenario above is that the threat is evolving from minor incidents into a major disaster. The situation lasted over an extended time period, some two weeks, leading to escalating difficulties. The effects were not only limited to Finland, but extended to other Baltic Sea Region countries as well. The disaster affected the whole Baltic Sea region.

That reference (worst-case) scenario is based on extreme but realistic weather conditions, which are possible but not necessarily very likely. The scenario will provide for a circumstantial framework and

[197] For the technical basis see report by Juha Rautjärvi, Pekka Visuri and Martti Annanmäki, Sudy on nuclear safety: identification of the gaps in disaster prevention and coping strategies of the Baltic Sea region countries (Flagship Project EUBSR 14.3 Task F), May 2013.

particular conditions causing incidents and accidents on land and sea that will be followed by the nuclear reactor incident releasing radioactive substances into the environment.

The scenario sets a list of conditions which can occur - if not exactly this way – and on that basis it is possible to feature the premises for crisis management assignments and rescue services in surprising and multifaceted situations which demand comprehensive cooperation both nationally and in the regional framework. It is only an example of many combinations of disasters following from extreme weather conditions and breakdowns of critical infrastructure.