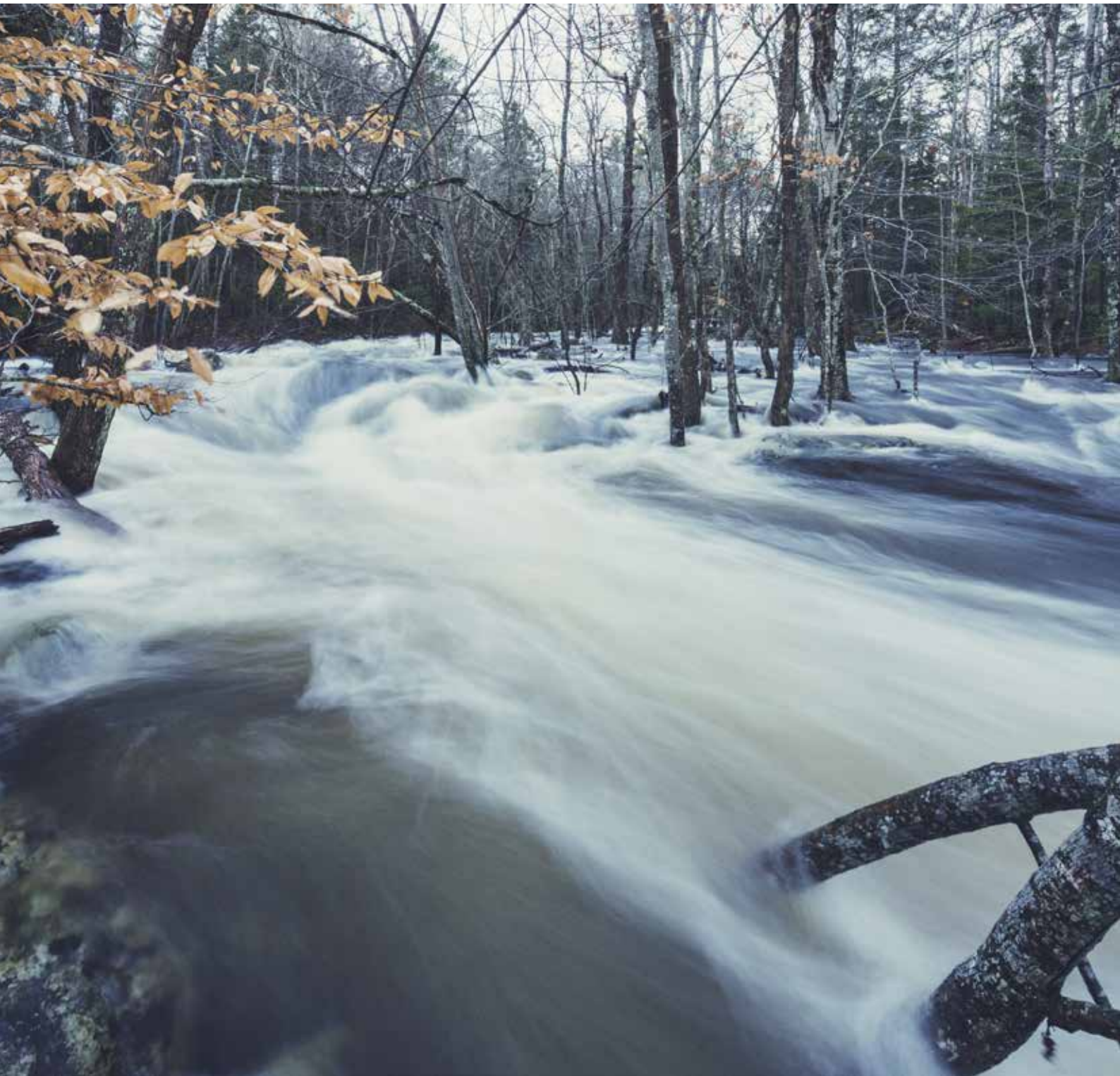
Swedish Civil Contingencies Agency

A summary of risk areas and scenario analyses 2012–2015



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The Swedish Civil Contingencies Agency (MSB)

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Innehåll

Summary

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This report presents an overview and synthesis of the 14 scenario analyses conducted as part of the national risk and capability assessment between 2012 and 2015. The report thus represents a response to Assignment 16 of MSB's appropriation for 2015.

The report presents a comprehensive overview of the different risks Sweden faces, risks which could have a serious impact on key Swedish national values of protection: *human life and health, society's functionality*, *economy and the environment*, *democracy*, *rule of law*, *and human rights and freedoms*, and *national sovereignty*.

For the purpose of clarity, MSB has categorised the risks into four main categories. The four main categories are: *natural hazards*, *major accidents*, *disruption to technical infrastructure and supply systems*, and *antagonistic hazards*. The types of risk that could arise, their impact, examples of past incidents, and the responsibility in relation to these risks are discussed for each category.

Where MSB has conducted a scenario analysis in relation to the risk area, the results of this are presented after the initial risk description. Each scenario has been analysed based on the capability of society to prevent and respond to the scenario in respect of its potential impact on Sweden's national values of protection. Each analysis also includes a discussion related to the likelihood, sensitivity, and uncertainties pertaining to the scenario.

The results of the impact assessments from the scenario analyses and the most prominent examples of capabilities that need to be developed based on each scenario analysis are presented under the heading *Overview of the analysed risks* in Section 1 of the report. Section 1 concludes with a synthesis of key capabilities that need to be developed and which MSB wishes to draw special attention to based on all of the scenario analyses. Special attention has been drawn to four parts in particular:

1. The importance of working with individual risks based on an all-risk perspective.
2. The capability to maintain critical infrastructure.
3. The capability to manage information securely.
4. The capability for co-ordinated action in the event of an incident.

Section 1: Assignment and overall conclusions

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National risk and capability assessment

The national risk and capability assessment plays an important partin the development of society's capability to prevent and respond to disasters at all societal levels. The goal of the assessment is to form a strategic basis to further develop civil contingency.

The assessment has evolved in an ongoing process since the establishment of the Swedish Civil Contingencies Agency (MSB) and has previously been conducted by the Swedish Emergency Management Agency. It is primarily based on the governmental agencies risk and vulnerability analyses, but since 2011 has been developed as part of EU co-operation related to disaster risk reduction. Since 2012 the assessment has been supplemented with scenario analyses based on common guidelines[1] for EU member states with the aim of creating opportunities for increased co-operation and the exchange of experience in the field.

This report presents an overview and synthesis of the scenario analyses conducted as part of the national risk and capability assessment between 2012 and 2015. The report thus represents a response to Assignment 16 of MSB's appropriation for 2015.

The Assignment

In the 2015 appropriation, MSB was commissioned to conduct a national risk assessment:

"16. The Swedish Civil Contingencies Agency in co-operation with relevant stakeholders shall present a national risk assessment. The risk assessment shall constitute the basis for Sweden's reporting to the European Commission in accordance with Article 6 a of Decision No 1313/2013/EU of the European Parliament and of the Council.[2] The report must be submitted to the Government Offices of Sweden (Ministry of Justice) no later than 2 October 2015."[3]

EU guidelines and civil protection legislation

In 2011, the Council (of Ministers) of the European Union passed so-called Council conclusions on the development of risk assessments for disaster management within the European Union. According to the Council's conclusions, standarised national risk assessments will contribute to a common understanding of the risks facing the EU.[4] This is in turn anticipated to facilitate co-operation between member states in the prevention and response of shared and cross-border disasters. It is hoped that comparable national methodologies may also be used by regions or member states facing similar risks in making joint assessments. These assessments would ideally be capable of contributing to political contingency priorities.

1. Council conclusions on Further Developing Risk Assessment for Disaster Management within the European Union. 11–12.4.2011. (8068/11); Commission Staff Working Paper: Risk Assessment and Mapping Guidelines for Disaster Management.
2. Member states must draw up risk assessments at the national or appropriate sub-national level and provide the Commission with a summary of the relevant parts of these assessments no later than 22 December 2015 and every three years thereafter.
3. Ministry of Defence, *Appropriation for the 2015 fiscal year regarding the Swedish Civil Contingencies Agency*, Decisions Fö2014/125/ESL (in part), Fö2014/987/SSK, Fö2014/1535/SSK etc.
4. Council conclusions on Further Developing Risk Assessment for Disaster Management within the European Union. 11–12.4.2011. (8068/11).

The Council's conclusions reference the Commission's guidelines for the assessment and identification of risks associated with disaster management.[5] The guidelines provide general guidance for the development of national risk assessments, including certain definitions. They relate to the assessment of all types of disasters both within and outside the EU, with the exception of armed conflicts, terrorism, and other antagonistic threats.

In 2011, the European Commission invited all member states to submit their national risk assessments to the Commission. At this point Sweden reported its national risk identification as a first step towards a national risk assessment. As of 1 January 2014, the EU has tightened the requirements for member states regarding work on national risk assessments. Under new civil protection legislation adopted in December 2013, member states are required to submit a summary of risk assessments at the national or appropriate regional (sub-national) level to the European Commission no later than 22 December 2015 and every three years thereafter.[6]

Sweden's work in relation to EU guidelines

Sweden's work within the framework of the national risk and capability assessment is based on and follows the European Commission's guidelines for the assessment and identification of risks, with a degree of variance.

In Sweden, the impact of a scenario is analysed in relation to Swedish national values of protection, however this is presented in relation to the EU's three impact categories: *Human*, *Economy/Environment*, and *Political/Social*. The national values of protection are closely linked to the EU's impact categories, but include other kinds of impact. The relationship between Sweden's national values of protection and the EU's impact categories is shown in Table 1.

SWEDISH NATIONAL VALUES OF PROTECTION	SIMILARITY/DIFFERENCE	IMPACT CATEGORY IN EU GUIDELINES
Human life and health	Identical to >	Human
Economy and the environment	Identical to >	Economy/Environment
Democracy, rule of law, and human rights and freedoms	Covered partially by >	Political/Social Impact
National sovereignty	Covered partially by >	
Society's functionality	Affects >	All three categories

Table 1: Relationship between Sweden's national values of protection and the EU's impact categories. See Annex 1 Overall process and procedure description for in-depth information on what the national values of protection and the EU's impact categories involve.

According to the guidelines, a national risk assessment should include a risk evaluation: an evaluation of whether the risks are acceptable. Measures should then be prioritised based on this risk evaluation. MSB deems it very difficult, if not impossible, to determine thresholds for acceptable levels of risk. Furthermore measures should not be prioritised based on a risk evaluation, but should instead be prioritised based on vulnerabilities and deficiencies in capabilities identified in the scenario analyses. Consequently, the Swedish assessment does not include a risk evaluation.

5. Council conclusions on Further Developing Risk Assessment for Disaster Management within the European Union. 11–12.4.2011. (8068/11); Commission Staff Working Paper: Risk Assessment and Mapping Guidelines for Disaster.
6. Decision No 1313/2013/EU of the European Parliament and of the Council of 17 December 2013 on a civil protection mechanism for the Union.

EU guidelines do not include guidance on the assessment of risk scenarios relating to armed conflicts, terrorism, or other antagonistic threats. MSB has, however, chosen to include all hazards that could threaten Swedish national values of protection (all-hazards approach). Analyses linked to armed conflicts and civil defence are not currently conducted; however, examining the possibility of including the entire scale of risk, i.e. efforts that also involve civil defence and protection against accidents is a key ambition for ensuring cohesion in future Swedish efforts.

Implementation

Based on the risk identification and scenario analysis within the national risk and capability assessment, Section 2 presents a comprehensive overview of various types of risk faceing Sweden which could have a serious impact on the Swedish national values of protection.

For the purpose of clarity, MSB has categorised the risks into four main categories. The four main categories are: *natural hazards*, *major accidents*, *disruption to technical infrastructure and supply systems*, *and antagonistic hazards*.

Section 2 of this report also presents the scenario analyses conducted by MSB within the framework of the national risk and capability assessment since 2012. Table 2 below shows that 14 scenarios have now been analysed and are included in the national risk and capability assessment. Scenario analysis will continue to examine risk areas for scenarios that have yet to be analysed, such as storms and flooding. In the process of compiling the 14 scenarios, the ambition has been to supplement the analysis with relevant new knowledge as much as possible. Deficiencies detected in each scenario analysis may have been reduced since the analysis was conducted.

RISK CATEGORY	SCENARIO ANALYSIS	YEAR
Natural hazards	Volcanic eruption in Iceland	2014
	Solar storm	2014
	Mudslide	2014
	Heat-wave	2013
	Pandemic flu	2013
Major accidents	Fire on cruise ship	2012
	Dam failure	2012
	Nuclear accident	2013
Disruption to technical infrastructure and supply systems	Disruption in GNSS	2013
	Disruption to food supply	2012
	Diesel in the supply of drinking water	2012
Antagonistic incidents	Bomb attack	2013
	School shooting	2012
	Violent disturbances	2013

Table 2: Scenario analyses conducted 2011–2014. With some exceptions, the analyses have been carried out in a workshop format with experts from among the relevant stakeholders. In cases where extensive documentation has been available, analyses have been carried out on the basis of interviews and by studying the literature. Refer to each analysis in Section 2 of this document for more information.

Comprehensive overview of the analysed risks

A total of 14 scenarios have been analysed within the framework of the national risk and capability assessment. Common to all scenarios is that they consist of hazards that occur infrequently yet have a serious impact on society when they do occur – see Figure 1.

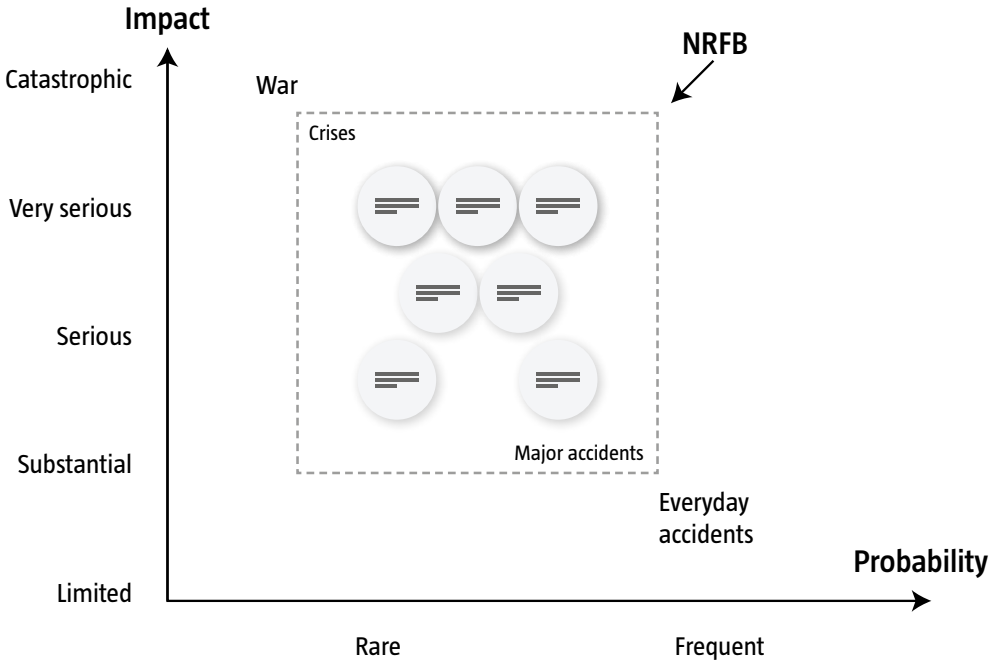

Figure 1: Schematic description of NRFB's current focus: low probability hazards – disasters and major accidents – that have a serious impact on important societal values of protection. All of the scenario analyses conducted fall within this framework.

Each scenario has been analysed based on the capability of society to prevent and respond to the scenario in respect of its potential impact on Sweden's national values of protection. Each analysis also includes a discussion regarding the probability, sensitivity, and uncertainties pertaining to the scenario, as well as its impact. The scenario analyses can be found in full in Section 2. Below is a summary of the risks and the scenario analyses carried out in tabular format, with the impact "translated" into the EU's impact categories. Consequently, the assessments are made based on the 1) Human, 2) Economic/Environmental, and 3) Political/Social impact.

Note that a scenario analysis is one possible manifestation of a hazard and should not be seen as a complete representation of the hazard in question.

NATURAL HAZARDS

Risks	Scenario	Scenario impact		
		Human	Economy/Environment	Political/Social
Earthquake and volcanic eruption	Volcanic eruption	Serious	Not assessed	Limited
Landslides	Mudslide	Very serious	Very serious	Substantial
Flooding				
Storm				
Heat-wave	Heat-wave	Serious	Serious	Limited
Forest and vegetation fire				
Contagious diseases	Pandemic flu	Catastrophic	Catastrophic	Very serious
Antibiotic resistance				
Attacks by pest insects				
Solar storm	Solar storm	Not assessed	Catastrophic	Substantial

*Table 3: Risks and scenario analyses carried out in the category **natural hazards**. Analyses of floods, storms, forest and vegetation fires, antibiotic resistance, and attacks by insect pests have not thus far been carried out.*

MAJOR ACCIDENTS

Risks	Scenario	Scenario impact		
		Human	Economy/Environment	Political/Social
Transport accidents				
Extensive fires	Fire on cruise ship	Very serious	Very serious	Substantial
Emissions of hazardous substances (CBRNE)	Nuclear accident	Serious	Catastrophic	Very serious
Dam failure	Dam failure	Serious	Catastrophic	Allvarliga

*Table 4: Risks and scenario analyses carried out in the category **major accidents**. Analyses of transport accidents have not thus far been carried out.*

DISRUPTION TO TECHNICAL INFRASTRUCTURE AND SUPPLY SYSTEMS

Risks – Disruption to...	Scenario	Scenario impact		
		Human	Economy/Environment	Political/Social
Power supply				
Electronic communications	GNSS	Limited	Serious	Limited
Payment systems				
Food supply	Food supply	Limited	Very serious	Substantial
Supply of drinking water	Diesel in drinking water	Limited	Limited	Substantial
Transport system				
Drug supply				

*Table 5: Risks and scenario analyses carried out in the category **disruption to technical infrastructure and supply systems**. Analyses of disruption to energy supplies, payment systems, transportation, and the supply of medicines have not thus far been carried out.*

ANTAGONISTIC INCIDENTS

Risks	Scenario	Scenario impact		
		Human	Economy/Environment	Political/Social
Cyber-attacks				
Terrorism	Bomb attack	Very serious	Very serious	Very serious
School shooting	School shooting	Substantial	Limited	Serious
Violent disturbances	Violent disturbances	Serious	Substantial	Serious

*Table 6: Risks and scenario analyses carried out in the category **antagonistic hazards**. Analyses of cyber-attacks have not thus far been carried out.*

Each scenario analysis has highlighted various needs for developing the capability to prevent and respond to the risk in question. The table below provides a summary of the most prominent examples of these needs.

SCENARIO ANALYSIS	PREVENTATIVE CAPABILITY REQUIREMENTS, E.G.	MANAGEMENT CAPABILITY REQUIREMENTS, E.G.
Volcanic eruption (volcanic dry fog)	Knowledge building.	Knowledge building. Develop planning and other preparations.
Mudslide	Knowledge building through mapping. Avoid construction in vulnerable areas. Support existing built-up areas.	Knowledge building through mapping. Communicate the availability of national reinforcements. Develop availability of expertise.
Heat-wave	Ensure robustness of infrastructure that is vulnerable to heat.	Prepare resource priorities. Ensure procedures for crisis communication with a particular focus on vulnerable groups.
Pandemic flu	Communication with the public. Ensure confidence in authorities and their information.	Ensure planning and other preparations such as health care resources. Ensure the ability to provide and receive international assistance.
Solar storm	Ensure robustness of infrastructure for electricity distribution (transformers). Ensure the supply of backup power.	Knowledge development, forecasting, and early warning. Ensure the human resources requires for repairs. Ensure the ability to provide and receive international assistance. Ensure the supply of backup power. Prepare resource priorities.
Fire on cruise ship	Ensure procedures for fire protection – e.g. local protection on specific vulnerable objects.	Ensure procedures for an effective response.
Nuclear accident	Ensure maintenance, procedures, and inspections of facilities.	Ensure planning and other preparations. Ensure skills, exercise. Develop preparations for action during a prolonged incident.
Dam failure	Ensure maintenance and strengthening of facilities.	Ensure planning and other preparations – e.g. evacuation.
Disruption in GNSS	Knowledge building. Reduce dependence on GNSS, develop secure information management.	Knowledge building. Ensure redundancy and alternative resources. Ensure skills, exercise.
Disruption to food supply	Develop efforts for robust food supply. Knowledge building, supported by performance targets.	Develop planning and other preparations – e.g. resource prioritisation. Develop private public co-operation at the national level.
Disruption to the supply of drinking water	Knowledge building.	Develop planning and other preparations – e.g. resource prioritisation. Ensure emergency water resources.
Antagonistic incidents (Bomb attack, School shooting, Violent disturbances)	Ensure knowledge. Link preventative efforts to risk factors, such as political, economic, and social marginalisation.	Ensure planning and other preparations, exercise. Develop networks to indicate when social unrest can become a violent disturbance. Ensure procedures for intervention. Clarify roles of responsibility and co-operation.

Table 7: Examples of the needs identified in each analysis regarding the capabilities to be developed. In cases where the current capability is deemed assessed to be sufficient and requiresmaintained or strengthened to a degree, the term "ensure" is used. In cases where capabilities clearly need to be developed, the terms "develop" or "establish" have been used.

Capabilities to be developed

In this subsection, MSB draws special attention to capabilities which are based on a synthesis of capabilities and vulnerabilities arising from the 14 scenario analyses.

The importance of working with individual risks based on an all-hazard approach

Each of the risks considered in this assessment potentially result in disasters that society must have the capability to prevent and respond to. To reduce the relevant risk, it is necessary to work with the needs identified in each scenario analysis.

Knowledge of the hazards that can occur and how they affect society is a prerequisite for implementing relevant preventative and response measures. Knowledge of each stakeholder's role and responsibility forms part of this.

It is important to emphasise that the necessary steps within each risk area are not limited to those intended to improve the response capability. In some situations, the response capability and its effectiveness have only a marginal effect on the overall impact. Preventative efforts focusing on why disasters could occur are complex but effective when successfully conducted : complex because the work can be costly and the expected results are far in the future; effective in that in a best-case scenario, the occurrence of a disaster can be prevented. Much of the preventative work – particularly thatwhich addresses underlying causes – does, however, fall within the framework of other policy areas and activities, and is not traditionally seen as a natural element of civil contingency.

For the remainder of this section, MSB has instead chosen to focus on measures that develop capability and which have a significant impact in relation to the many risks. The measures relate primarily to three of the capabilities that MSB is working to develop within civil contingency: 1) The capability to maintain critical infrastructure, 2) the capability to manage information securely, and 3) the capability for co-ordinated action should an incident occur.

Capability to maintain continuity in critical infrastructure

Stakeholders from public administration, trade and industry, civil society and individuals should be involved in developing capability. Critical infrastructure is important for two reasons: 1) a shutdown of or severe disruption in this activity alone, or together with similar incidents related to other activity, can quickly result in a major disaster occurring in society, and 2) the activitiy are necessary or essential for the response to an incident.

In this section, focus is on activities comprising a vulnerable value of protection pursuant to reason 1 above (a shutdown of or severe disruption in these activities alone, or together with similar incidents related to other activities, can quickly result in a major disaster occurring in society). By making the infrastructure more robust and resilient, the worst impacts of various kinds of strain, such as severe weather conditions, can be prevented. In recent years, many power lines have as an example been placed under ground. Subsequently, the vulnerability of the power grid and ultimately the power supply in the event of a storm has reduced considerably. Other measures closer to the incident itself have more of a response (preparatory) focus. This may involve, for example, developing plans and procedures – continuity planning – to maintain certain activities and ensure continued supplies despite disruption. Through its *Action Plan for the Protection of critical infrastructure*, MSB is working to implement systematic security measures in critical infrastructure.

The critical infrastructure that is affected and the extent to which they are affected depend on the incident in question. From the perspective of dependence, some activities are notably more important. Disruption to activities that maintain services, including power supply, electronic communications, the supply of drinking water, transport, and IT security, has rapid cascading effects for the rest of society. This is exemplified primarily in the following scenarios: *Solar storm*, *Disruption to food supply*, *Disruption to GNSS,* and *Diesel in the supply of drinking water*. The problem has also been confirmed by earlier assessments based on the authorities' risk and vulnerability analyses. For this reason it is important that the following areas are developed for all stakeholders providing critical infrastructure, with a focus on developing robustness and ensuring the availability of adequate resources:

ENSURING A SUSTAINABLE POWER SUPPLY

Ensuring the availability of sustainable backup power for critical infrastructure.

The stakeholders responsible should continue to develop and systematically practise procedures for the start-up and operation of backup power for critical infrastructure.

The analyses show that large segments of society would bewithout power and that such disruptions to the power supply present not only a consequential impact in itself, but potential cascading effects for other critical infrastructure. The power supply has a special significance within the energy system since electricity is almost always required for the supply of all other types of energy. In addition, the supply of electricity is critical for the functioning of other activities, including electronic communications, transport, food supply, health and medical care, social care, and municipal technical services.

There are many potential causes of disruption to the power supply. These include storms, torrential rain, solar storms, the breaking of a dam, and antagonistic actions. For the activities affected, the cause is rarely of much importance. When the grid is no longer able to supply electricity, backup power can be used or activities can be run without power using alternative procedures.

With regard to the power supply, MSB identifies serious deficiencies in the availability of backup power. This has been identified not only in several scenario analyses, but also consistently in earlier assessments based on risk and vulnerability analyses. In addition, these assessments reveal the sustainability of backup power supplies to be deficient, primarily due to uncertainties in how, for example, diesel can be supplied to backup power equipment. Although some supplier agreements have been put in place, there is uncertainty regarding diesel supplies in the event of serious incidents. Procedures for how the stakeholders test, maintain, and start up their backup power varies.

In 2014, *Guidelines for managing the backup power process* (MSB, 2014) was developed for all stakeholders. The guidelines clarify all the steps from a needs analysis to care and maintenance and efforts to improve the availability and sustainability of backup power.

ENSURE A SUSTAINABLE SUPPLY OF DRINKING WATER

Ensure access to drinking water by for example, backup water-supply sources or emergency water.

The stakeholders responsible should continue to develop and systematically practise procedures for the use of backup water-supply sources and emergency water for critical infrastructure.

The supply of drinking water is heavily dependent on both electricity and electronic communications. The functionality of a number of other sectors in society in turn depends heavily on the supply of drinking water, as does the supply of food and health care. Moreover, a very high percentage of Sweden's population (90 per cent of permanent housing) relies on municipal water supplies.

Many waterworks are not equipped with backup power and will not be able to operate in the event of a power outage. Drinking water systems are often constructed independently, which means there is a non-existent or only limited possibility of connecting one system to another.

Several water conservation areas where groundwater is pumped to waterworks lack contingency plans for the supply of drinking water. Based on information from the Swedish National Food Agency, MSB assesses that it is possible to provide drinking water, for instance via tanks (emergency water), to relatively large urban areas. In larger cities, it is currently not possible to provide all residents access to emergency water.

In addition, the quality of raw water may be adversely affected by future climate change. Similarly, earlier capability assessments indicate that the infrastructure for the water supply and sewer system is old, and that financial provisions for its adequate modernisation have not always been made. MSB assesses that this presents additional challenges for the future supply of drinking water.

In 2013, the government appointed a special investigator to examine the challenges to the country's safe supply of drinking water. The outcome of this will be reported in 2016.

ENSURING SUSTAINABLE ELECTRONIC COMMUNICATIONS

Ensuring access to secure communication routes and backup communication procedures for critical infrastructure.

The stakeholders responsible should continue to develop and systematically practise the use of secure communication routes and backup communication procedures for critical infrastructure.

The report establishes that disruption to electronic communications can be caused by a variety of incidents in the same way as for disruptions to the power supply. The impact of an incident depends on what systems are affected. In general, difficulties in communicating arise both between people and between systems, as well as for people monitoring various systems.

Dependence on these systems is complex and not always apparent; however disruption can, for example, have an impact on the monitoring and management of the power supply, the supply of drinking water, and transport. Access to digital information can be difficult, which affects virtually all sectors of society in different ways.

Electronic communications are becoming increasingly important in a more information-dependent society. MSB assesses that municipal stakeholders are largely lacking in alternative communication routes. This means that work involving information and communication is relatively unlikely to be sustainable in the event of a disaster. Similarly, earlier capability assessments show that several county councils have not yet implemented RAKEL (radio communication for effective management) as the primary means of communication in, for example, their co-operation with other contingency officials.

ENSURING SUSTAINABLE TRANSPORT SYSTEM

Ensuring availability, redundancy, and security in transports.
Ensuring robustness and redundancy in the transport infrastructure.

The report shows that serious transport disruption or disruption to a transport hub, such as a port or airport, may have a devastating impact on society. The scenario analysis disruption to food supply shows how vulnerable society is in the event of disruption to transport. Disruption results in a major strain on society from day one of the incident. The scenario analysis shows that all parts of the food chain depend on transport and large parts are also of a "just-in-time" nature, which means minimal storage at all stages. This results in considerable vulnerability if something interferes with the normal flow.

The report also shows that many of society's other critical functions are critically dependent on transport infrastructure, including emergency care, elderly care, drug distribution, the transport of valuables, the police, rescue services, security services, and repair services for the power supply, electronic communications, and district heating. If the infrastructure is destroyed or damaged, its needs to be possible to reroute transport or to establish alternative infrastructure in the form of roads, bridges, etc.

Ability to manage information securely

In recent years, information- and cybersecurity have become an increasingly important function on the basis of the dependency perspective outlined above. There are a number of ways in which its infrastructure can be damaged, including natural hazards (e.g. flooded server rooms), and antagonistic events. The resulting disruption has a consequential impact that affects the functionality of many other sectors of society. Additionally, in many instances it is important to manage information securely, such as by ensuring that information is available and trustworthy, so as not to worsen the impact of an incident.

Technology is developing rapidly, which means that vulnerabilities can be targeted and exploited more quickly than the problem can be identified and resolved. The rapid development of technology also places great demands on the client. Unlike the physical electrical system, for instance, there are many more individuals who have access to powerful tools for influencing various IT systems, making it possible to inflict considerable damage with small means.

This assessment addresses the problem of information and cybersecurity mainly in the *cyber attacks* section. Earlier capability assessments have noted that this area is particularly vulnerable.

DEVELOPMENTS IN INFORMATION AND CYBERSECURITY

Systematic work on information security needs to be developed within authorities as well as among other stakeholders who are responsible for critical infrastructure.

Better conditions are needed for developing a national information security status report.

Systematic work on information security needs to be developed within authorities as well as among other stakeholders who are responsible for critical infrastructure. This includes greater support for risk analysis, information classification, and continuity management.

Furthermore, MSB identifies that there is a continued need for better conditions for an information security status report, such as by way of incident reporting in order to increase the capability of preventing and responding to incidents at the society level. MSB has, for instance, begun revising the regulations for information security and intends to continue developing efforts in this area. Additionally, MSB is continuing efforts to develop a comprehensive information security status report for state administration and the rest of society.

Measures in this area will most likely be affected by the final report of the NISU 2014 information security inquiry and Swedish Security Protection Act inquiry, as well as by how the proposals of these inquiries will be addressed by the government.

The capability for co-ordinated action in the event of an incident

Activities that have an important role in the management of a disaster are also important to society (see reason 2 above). Regardless of the incident, considerable demands are placed on these stakeholders' capability to lead, co-operate, and communicate. The greater experience and knowledge of the nature of the incident and of the stakeholders cooperating, the more effective the collaboration in responding to the incident. Resources are often a limitation. This is why procedures are vital to the effective distribution of resources among stakeholders.

The scenario analyses reveal that the same types of needs and deficiencies exist in other assessments carried out by MSB, such as the risk and vulnerability analyses. These needs and deficiencies have been formulated here into the following conclusions.

DEVELOPMENTS INMONITORING AND ALERTING

The stakeholders responsible should continue developing their global monitoring systems and develop and systematically practise procedures for alerting and receiving alerts.

To ensure stakeholders have the capability to issue a timely alert before an incident, a functioning monitoring system is required. This requires stakeholders to have the necessary expertise for evaluating the information and recognising warning signals. With regard to the capability to issue and receive alerts, earlier capability assessments indicate most stakeholders have procedures for issuing an alert, however deficiencies exist in the execution of procedures.

DEVELOPMENTS IN CO-OPERATION, MANAGEMENT, COMMUNICATION, EXPERTISE, AND RESOURCES IN THE EVENT OF A DISASTER

Stakeholders with responsibility should continue to develop and systematically practise plans and procedures for co-operation, management, and communication during crises.

MSB's scenario analyses show that in most cases general planning, structures, and procedures are in place for disaster management before and during an incident. In some cases these preparations are linked to specific disasters. Nevertheless the following requirements should be addressed in this context.

Co-operation and management

The need to develop co-operation emerges from several of the 14 scenario analyses as well as from earlier capability assessments. Extensive co-operation is currently underway in various forms and networks, especially among relevant stakeholders in the public administration. Co-operation initiatives between public and private stakeholders – especially those responsible for critical infrastructure – remains inadequate, however. Similar to planning and procedures in general, it is important that formal co-operation also results in real focus and co-ordination for both prevention and management (preparatory) work. There is potential for improvement.

With regard to co-operation and management in the event of an incident, including the need to develop co-operation procedures. MSB's Co-operation and Management project has recently been completed. The main conclusions of the project are documented in the final report *Shared bases for co-operation and management in the event of social disturbances* and contains ways of thinking and working to increase the capability of managing such incidents. These bases are being implemented in the work of MSB and other stakeholders.

One very specific challenge in terms of planning that has become apparent in a number of scenario analyses relates to the need to evacuate people quickly, e.g. in the event of a *bomb attack*, *mudslide*, or *nuclear accident*. Evacuation capability – the presence of evacuation plans and evacuation drills, for instance – has not been studied in detail in the analyses. Due to the initiative of the SOSUV (a co-operation area of protection, rescue, and care), MSB has, in co-operation with other stakeholders, developed guidlines for planning and preparing a large-scale evacuation.

Communication

The rapid distribution of co-ordinated and consistent information in the event of an incident is always a major challenge. This is exemplified in the *bomb attack* scenario, but applies regardless of the type of disaster. This may be due to considerable social unrest, a limited general knowledge of how society is affected by specific risks, and many stakeholders co-ordinating their messages, or due to limited communication opportunities as a result of the incident. Disaster communications have been developed in recent years. MSB concludes there is a considerable need for information and communication during crises.

Competence

The existence of effective planning and procedures is one element; application is another. For this reason staff awareness – through training or experience of incidents – of how to comply with plans and procedures is essential.

MSB concludes that exercises are currently conducted at all levels of society, and that interest in carrying out exercises remains high. A systematic approach to training exercises is important. The management of experiences following the exercises needs to make more of a contribution to the work of the stakeholders taking part in the exercises in order to develop their capability to respond to incidents.

Resources

Several scenario analyses, such as the *heat-wave* and disruption to food supply scenarios, demonstrate that priority systems regarding resources are lacking. An important question is who is accountable for such information before or during an incident.

Several scenario analyses, such as the *pandemic flu* scenario, demonstrate the importance of having procedures for sending and receiving reinforcement resources. In addition, the *pandemic flu* and *solar storm* scenarios identifies the capability to to effectively utilise international aid.

Many analyses reveal large deficiencies in the availability of human resources. Personnel shortages, whether due toquantity (station contractors in the *solar storm* scenario), or because they cannot be accessed quickly (geotechnical expertise in the *mudslide* scenario), or both (experts in e.g. the health effects of chemical substances in the *vulcanic eruption* scenario). This could also mean a large increase in the general need for staff for a longer period of time, i.e. sustained need (need for rescue service personnel for long-term efforts). The *pandemic flu* scenario deals with difficulties in sustaining a workforce in several different areas when a significant number of the staff are absent. The *nuclear accident* scenario deals with theshortage of staff experienced in the analysis of radiation measurements. Health and social care is one of the worst-affected sectors of society in a number of incidents. In many cases, health care will be subjected to considerable strain.

Section 2: Risks and scenario analyses

Natural hazards

Section 2: Risks and scenario analyses

1. Natural hazards

"Natural hazards" means incidents that are primarily caused by natural forces or phenomena, although human activity – e.g. by way of greenhouse gas emissions – may result in climate change, which affects the probability of these incidents occurring.

To support the identification and compilation of natural hazards, they can be sorted into subcategories. The UN has chosen to define natural hazards according to their different origins in three groups: geological, hydrometeorological, and biological.[7] This report follows the UN's categorisation, with the addition of the category "Extra-terrestrial". Examples of incidents in each category are presented in the table below.

GEOLOGICAL	HYDROMETEOROLOGICAL	BIOLOGICAL	EXTRA-TERRESTRIAL
Earthquake and volcanic eruption	Flooding	Infectious diseases	Solar storm
Landslips and landslides	Storm	Antibiotic resistance	
	Heat-wave	Attacks by insect pests	
	Forest and vegetation fire		

Table 8: Examples of natural hazards divided into four subcategories.

1.1 Earthquake and volcanic eruption

The lithosphere, which is the earth's top layer, is divided into several plates that are constantly moving. When the plates collide or rub against each other, it can cause earthquakes and volcanic eruptions. Sweden experiences some occasional seismic activity and there are between 500 and 700 earthquakes per year. Most of these are magnitude 2.0 on the Richter scale and can only be recorded by stations measuring seismic activity. Nevertheless, roughly once a year an earthquake occurs with a magnitude of 3.0 or higher, which usually can be clearly felt. For instance, a magnitude 2.8 earthquake occurred about 15 kilometres south-west of Gothenburg on 29 July 2015. The quake was heard and felt throughout the Gothenburg area, but no injuries were reported.

Earthquakes can damage buildings and cause landslips. Earthquakes have, for instance, caused mines to collapse. In 2008 this resulted in one death at the Kiruna mine.

Sweden has no active volcanoes, although volcanic activity from other countries, particularly Iceland, can have a negative effect on Sweden. One possible impact of a volcanic eruption is the creation of a cloud of accumulated volcanic gases called volcanic dry fog, consisting of sulphur dioxide, sulphuric acid aerosols, and sulphate particles. Volcanic dry fog could be transported by air to Sweden and have a negative impact on society.

7. UN/ISDR, 2006-03-29.

Europe has previously been affected by ash and gases from volcanic eruptions in Iceland. The eruption with the most serious impact and which resulted in volcanic dry fog across Europe was the eruption of the Laki volcanic fissure between 1783 and 1784, in which an estimated 20 per cent of Iceland's population died. Other examples of volcanic eruptions in Iceland that have had an impact on Sweden include the eruption of Eyjafjallajökull in 2010, which spewed ash into the atmosphere and led to a widespread grounding of flights throughout much of Europe. An eruption in the Veidivötn-Bárðarbunga volcanic zone of Iceland occurred in 2014–15. The eruption resulted in small concentrations of sulphur gases reaching both Norway and Sweden.

1.1.1 Responsibilities

There is no authority with the overall responsibility in Sweden for the impact of earthquakes or volcanic eruptions (and their ash and gases, including volcanic dry fog). During or immediately prior to an incident, the authorities and other stakeholders will become involved within the framework of their regular duties. If the extent of damage resulting from the incident is sizeable, the county council will be under pressure and will likely require support in the form of co-ordination and expertise from the National Board of Health and Welfare and other relevant authorities.

In the case of a volcanic eruption, the issue of responsibility is largely about the need for relevant knowledge. In a preliminary stage this includes SMHI, which – in the event of a meteorologically or hydrologically conditioned incident – has early warning systems. In the management of the incident and its impact – for example, ash or volcanic dry fog – expert authorities such as the National Board of Health and Welfare and the Swedish Environmental Protection Agency will be responsible for developing relevant information on how the substances are affecting the surroundings. MSB may need to assist in supporting co-operation (implementation of co-operation conferences), developing situation overviews, and co-ordinating information. The Swedish Transport Agency and Civil Aviation Administration will be involved in matters affecting air traffic.

1.1.2 Scenario analysis: Volcanic eruptions in Iceland

The analysis of this scenario was conducted in 2014 with two workshops. The first workshop was conducted with experts in various disciplines and related to the main question of what kind of health and environmental impact volcanic dry fog can have. This was followed by a workshop focusing on the response of the incident and the impact on society. Both local and national stakeholders took part. The results of the workshops were followed up and supplemented by literature studies and interviews.

Scenario

In the early summer, the Eldgjá volcanic fissure erupts. Ten days after the eruption starts, a volcanic dry fog reaches Sweden. The incident scenario then plays out over roughly two months.

Geographic location

All of northern Europe is affected by the volcanic dry fog. In Sweden it is primarily Östra Svealand and especially the area around Mälardalen that is affected. The local concentrations of sulphur dioxide and particles may be drastically different from the average values.

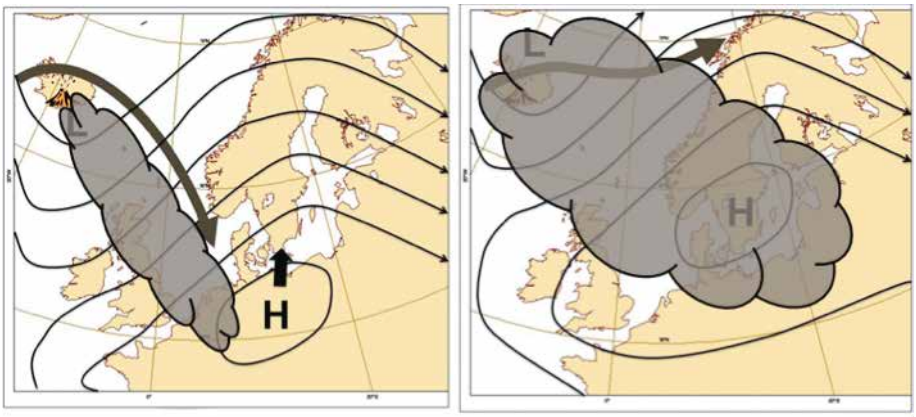

Figure 2: The spread of volcanic dry fog affects the whole of northern Europe.

Sequence of events

In March, the Icelandic Meteorological Office (IMO) records a number of earthquakes in the area around Katla, a volcano that has produced some of the most powerful eruptions in Iceland. On 23 May, the Eldgjá volcanic fissure, part of the Katla volcano system, erupts. Magma and gases billow out along a 75-kilometre long fissure.

On 2 June, just over one week after the eruption, the volcanic dry fog reaches ground level in Sweden. Initial sulphur dioxide concentrations and particles are small, and the impact are limited to slightly reduced visibility. The news of the volcanic dry fog dominates the media. Initially flights are grounded across Europe because of the ash, but this is lifted after a few days, apart from over northern Scandinavia.

Four weeks later, on 14 June, a maximum concentration level of sulphur particles is measured in Eskilstuna. Sulphur dioxide levels also reach their peak. Some vegetation looks singed and delicate plants wither and die. Farmers are worried about what will happen with their crops, and agriculture is predicted to suffer major economic losses.

On 10 August it rains. This brings the sulphur dioxide and sulphur particles in the air down to ground level. Sulphur compounds absorbed into the soil and drawn into waterways have an acidifying effect. By 23 August, three months after the first eruption, the situation in Sweden has been normalised.

Capability analysis

In the event of a volcanic eruption, it is important to issue warnings as early as possible so that people and businesses who may be affected have time to prepare. There are several early signs of an impending volcanic eruption. Examples include land heave and increased seismic activity, which may occur long before the volcano in question erupts. Eyjafjallajökull showed signs of eruption as early as the 1990s with a period of land heave which later subsided. This happened around 15 years before the actual eruption in 2010. Seismic activity beneath the volcano increased approximately three months before the eruption.

IMO and researchers at the University of Iceland monitor the country's thirty or so volcanoes in order to detect at an early stage whether an eruption is underway. This is in order to provide early warnings.

Once an eruption has occurred, modelling is used to estimate volcanic emissions in order to forecast the spread of ash and other products. In Sweden, SMHI and FOI develop models that include gas dispersion that are already able to forecast the transport of ash through the atmosphere on the basis of the prevailing weather conditions. Dispersion models have been developed both in Iceland and in the UK.

Sweden does not currently have any specific preparation, whether in the form of procedures, training, or exercises, to respond to the impact of a volcanic dry fog brought about by a volcanic eruption.

Sörmland County Council will be severely affected because of the large number of people turning to emergency and primary health-care facilities for help. There are eight health centres in Eskilstuna and five to ten doctors per health centre. There is a lack of respiratory care beds. Sörmland County Council will need relief and resource support from other counties. Legislation permits the affected county council to seek support from other counties, which then respond on the basis of their capability to help. The government can enable the National Board of Health and Welfare to decide that other county councils must help if required. This is, however, unlikely in this scenario. The National Board of Health and Welfare (together with other relevant authorities) would rather support the county council by offering co-ordination or resources in terms of, for instance, expertise or equipment.

Volcanic dry fog results in a good deal of information being demanded by the public and the media, primarily in Iceland but also in Sweden. This relates to the effect of volcanic dry fog on health and to how people can protect themselves, as well as to how drinking water, vegetation, and animals are affected. Forecasts and measurements of the dispersion and content of the volcanic dry fog, as well as interpretations of this data, will also be in demand.

MSB starts to monitor the development of a volcanic eruption at an early stage and establishes a national status report that provides a cross-sectoral description of the impact, disaster management measures, and co-ordination requirements. The environmental monitoring function will identify the incident and try to confirm what is happening. It will also clarify which stakeholders are affected and which may be affected going forwards. Contact is made first of all with SMHI and the Geological Survey of Sweden (SGU) at the onset of the incident. They will confirm what is going on and provide support in the assessment of how Sweden could be affected. Contact is also made with neighbouring Nordic countries.

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In the more acute stage, MSB will call an additional information co-ordination conference to agree on planned information measures and what may need to be co-ordinated. Information is shared through krisinformation.se, both online and through social media, with links being provided to information from other authorities.

It will be a challenge for the Municipality of Eskilstuna to address the concern of the municipality's residents. Many of the municipality's residents require information in languages other than Swedish. Communication takes place via the municipality's website, as well as via previously established information

channels such as Syrian and Finnish associations. The municipality's switchboard is expected to be heavily congested and the municipality may then need help answering calls. The municipality can issue an important public service announcement and use the radio station Sveriges Radio P4 and newspaper Eskilstuna-Kuriren to release information.

It is primarily the National Board of Health and Welfare that needs to give advice on how the county council should address the volcanic dry fog and, in turn, treat patients and provide information about the effects of the volcanic dry fog and how to act to minimise them. This is why it is important to prepare national-level questions and answers that the county council can use. Drinking water issues are primarily the responsibility of the Swedish National Food Agency, and the effects on vegetation and animals are primarily a matter for the Swedish Board of Agriculture and the National Veterinary Institute. In all these cases, the municipalities and county administrative boards have a responsibility to convey information from outside their geographic areas of responsibility. This is made more difficult as knowledge about the effects of volcanic dry fog is imprecise.

A common question might be how long the volcanic dry fog will remain over Sweden. SMHI's forecasts will be in demand. SMHI will be able to comment on how the incident will develop over the next 72 hours, but there is a degree of uncertainty in the forecasts, particularly in the long term.

In the event of a volcanic eruption, there will be considerable interest in the substances found in the gas cloud. Olfactory and visual stimuli are not enough to determine what the volcanic dry fog is made up of. There is a considerable need for data if experts are to be able to comment on the impact of the haze and provide recommendations.

The Swedish Environmental Protection Agency is the authority responsible for national environment monitoring with regard to air quality. This means that they follow developments over time for a number of substances and particles. Since sulphur dioxide no longer poses an environmental problem, continual measurements of this are no longer made.

Impact assessment

Human life and health

Many people suffer from headaches and feel irritation of the eyes, nose, and throat. Hay fever sufferers, who are already vulnerable at this time of year, are particularly affected. People with asthma and other lung diseases have difficulty breathing, with children and the elderly in particular having to seek medical care. The number of people on sick leave increases, as does the number of parents at home to look after their children. Even animals, primarily horses, are affected.

The overall assessment regarding life and health is that between 30 and 99 people will die and around 2,500 people will need medical care in Eskilstuna during the acute stage[8], in which concentrations of sulphur dioxide, sulphuric acid, and small solid particles which have an acute effect on health are at their highest. As high concentrations in other parts of east Svealand periodically arise during the summer, the number of people affected may be several times higher.

Within a few years, the health-care service will notice statistically significant increase in morbidity and mortality attributed to exposure. This will not, however, result in any noticeably increased strain on emergency care.

8. Around 100,000 people live in or around Eskilstuna.

Society's functionality

MSB assesses that the sectors of society worst affected by the volcanic dry fog are health and medical care, as well as social care and food. There will be a considerable need for care during short periods at certain geographical locations. In this scenario, Eskilstuna is affected by the highest concentrations, but other areas are also affected.

In Sörmland, the lack of space within health and medical care quickly becomes a problem and theyneeds to call in additional staff, cancel planned operations, and make patients share rooms. The strain will be greatest during the acute phase, but it is also expected elevated over the next year as many of the people seeking emergency medical care may need to be monitored with frequent checks afterwards.

In addition to health and medical care, the primary production of food will be badly affected. Growth will be significantly lower and yields may fall to around 50 per cent of their normal levels in the affected areas.

The food industry will also be affected. The part of the food industry that uses Swedish raw materials from the affected area will need to reduce production or import raw materials, while the availability of raw materials in Europe will have decreased and the demand for them increased.

In Sweden, a large proportion of the food consumed is imported. The key countries for grain, fruit, and vegetable imports are Denmark, the Netherlands, Germany, and Belgium. These countries are also assumed to have been affected to some extent by the volcanic dry fog, though not to the same extent as Swedish production. The impact would therefore be a reduced supply of fruit and vegetables on the Swedish market and thus higher prices.

Economic values and the environment

This scenario will, on the whole, have a major economic impact. Due to an insufficient knowledge base in the analysis, the level of uncertainty is, however, too high to conduct a quantitative assessment of the total costs. The largest economic impact for society is estimated to arise from the management of people seeking care, and from the environmental impact that arises. These become clear especially in the agricultural sector, which will suffer huge economic losses due to crop failure.

The environment will be affected by the volcanic dry fog in primarily two ways – due to the direct sulphur poisoning of plants as the concentration of sulphur dioxide rises, and by acid rain towards the end of the scenario.

Democracy, rule of law, and human rights and freedoms

The incident will result in public concern and a considerable need for information. The way in which this is manifested depends, for example, on how authorities respond to the situation and on the extent to which the information requested can be drawn up and distributed so as to make people feel in control of the situation. The incident may well lead to the spread of rumours in the form of various more-or-less-substantiated advice and techniques for avoiding the spread of the volcanic dry fog.

Probability

The probability of the formation of volcanic dry fog that settles over Sweden depends in part on the probability of a volcanic eruption and in part on the probability of the meteorological conditions being such that volcanic gasses are pushed down over Sweden.

On average, one volcanic eruption occurs in Iceland every three to four years. Most eruptions are of a size that has no effect on the rest of the world. Eruptions of the magnitude in the scenario analysed have historically occurred very rarely. The eruption in 2010 was, however, an eye-opener for disaster preparation stakeholders, other stakeholders, and the public primarily in northern Europe, who became aware that there are active volcanoes nearby that can have a direct impact on our lives.

There is no typical sequence of events that all volcanoes follow. It is possible that volcanic activity will subside after having shown signs of an imminent eruption, or that an eruption will take place without any prolonged underground activity. Despite these signs, it is impossible to predict exactly when or even whether an eruption will occur.

Uncertainty assessment

The scenario is based on the Laki eruption of 1783. There are, however, major uncertainties regarding how much gas was vented from Laki and how much of the gas made its way to Europe.

The impact is difficult to assess as the effects of volcanic dry fog have not been very well studied. There is additional uncertainty in the assessment regarding the impact of the gas on human and animal health and on the environment.

Research can be found on how humans react to particles and different gases, but not so much on the health impact of emissions from volcanoes. How sulphur dioxide affects human health is far from clear. The environmental impact is, however, relatively well described for the gases that have been considered to come to Sweden in this scenario. Nevertheless, an overall quantitative assessment of Sweden can be made only with great uncertainty.

Sensitivity analysis

If the volcanic dry fog brought hydrogen fluoride, its impact would be far more serious for both human and animal health, as well as for the environment.

Had the weather conditions not been as stable as described in the scenario, the impact would have been much milder. The haze would not have been pushed down to ground level nor remained in the same place for as long. Subsequently, this would not have had as extensive an impact.

Had the eruption taken place in the winter, the scenario would also have been milder, in part due to the weather conditions likely being more turbulent, and in part because the impact on health and the environment would have been somewhat milder. Plants would not have been as badly affected as the haze would not have coincided with the important growth period.

1.1.3 Capability to be developed

One major incapability in this scenario is society's low level of knowledge regarding what volcanic dry fog is and its effects. The eruption in the Veidivötn-Bárðarbunga volcano zone in Iceland in 2014–2015 has led to several stakeholders starting to examine this more closely. Examples of knowledge-building currently underway include the development of models by SMHI and FOI to include gas dispersion. These models can then forecast the dispersion of ash in the atmosphere earlier. More knowledge-building is desirable, especially with regard to volcanic dry fog.

There are currently no plans or procedures for how different stakeholders should react – e.g. with regard to the co-ordination of information and messages – in the event of volcanic dry fog. The development of plans and procedures for managing

this scenario better is desirable. This includes preparing impact analyses, skills networks, action plans, and plans for issuing information about incidents of this nature.

The lack of knowledge, plans, and procedures can make the management of this scenario less efficient than it could be. This is made more difficult when it comes to informing the public and the media. This is because the unease and demand for information are greater than for other incidents of this magnitude, and because it is difficult to prepare information on the effects of volcanic dry fog on human health, drinking water, wildlife, and vegetation. Information also needs to be produced in different languages, and stakeholders need to be able to manage international contacts, including the international media.

1.2 Landslides

Landslides refer to the rapid movement of soil which is whole to begin with. Depending on the nature of the landslide, the land mass is broken up into large floes or whole chunks. It may also become more or less liquid, which is known as a mudslide. Typical of landslides is that they often occur suddenly, without prior clear warning signs.

The conditions for landslides primarily depend on an area's topography, geology, hydrology, and the geotechnical properties of its soil layers, as well as on the changes and pressures caused by human activity, such as strains in the form of buildings or dredging. Landslides are common in Sweden during snow melt, the thawing of frozen ground, and periods of heavy rain. Landslides in Norrland are most common from February to May. In Svealand and Götaland, the frequency is more evenly spread during the year, but landslides are more common from August to December.

Most of the country's mudslides occur in Västra Götaland, Värmland, and Västernorrland. Mudslides usually occur in areas with gradients of over 10 percent. They can even occur at shallower gradients – e.g., as a result of human intervention or where the slope is adjacent to a watercourse.

The Tuve landslide is the most extensive to have occurred in the valley of the Göta River. It had a major impact on how we work with landslide risks in Sweden today. The Tuve landslide occurred on 30 November 1977 outside Gothenburg. The landslide was 800 metres long and 600 metres wide at its widest point. It covered a total of around 27 hectares. In just a few minutes 67 homes were destroyed, making 436 people homeless, with nine deaths and 60 people injured. The electricity network, telephone network, and water and sewerage pipes were destroyed, which affected many households outside the landslide area.

1.2.1 Responsibilities

Municipalities have a major responsibility for construction planning and for reducing the vulnerability of housing, infrastructure, and key activities in vulnerable areas.

Since the Tuve landslide, the Swedish Rescue Services Agency (now MSB) has been tasked by the government with taking responsibility for the nationwide mapping of landslide risks in urban areas. The purpose of this is to identify the urban areas which are not classed as stable. The maps show the areas where there is a risk of landslips and landslides. Work is still ongoing and forms part of

MSB's efforts to ensure that preventative measures against natural disasters are taken. Between 2009 and 2011, the Swedish Geotechnical Institute (SGI) carried out another government assignment – the so-called Göta River investigation – which mapped the landslide risks of the entire valley in a uniform manner.

MSB administers funds from a special appropriation in the state budget – appropriation *2:2 Preventative measures against landslides and other natural disasters* – from which the municipalities can apply for funds for preventative measures.

There is also a delegation for landslip and landslide matters under SGI's chairmanship, in which co-operation is continually carried out.[9] The delegation is a body for contact and co-operation for authorities working with landslip and landslide issues.

When a mudslide occurs, the rescue services have the primary responsibility for saving lives by evacuating everyone in the landslide area. Management of the mudslide will, however, involve a number of other stakeholders. Here the county administrative board has geographical area responsibilities at the regional level. This primarily involves initiating co-operation efforts and ensuring that the stakeholders involved co-ordinate their efforts. The affected municipality has geographical area responsibilities at the local level. To this end, the municipality also has a responsibility for initiating co-operation – with neighbouring municipalities, for instance – and for organising voluntary organisations. MSB can assist in supporting co-operation (implementation of co-operation conferences), developing situation overviews, and co-ordinating information.

1.2.2 Scenario analysis: Mudslide

This scenario is largely based on SGI's results from the Göta River investigation and the risk mapping developed within the framework of the investigation.

The analysis of the scenario was carried out in 2014 and is primarily based on interviews with the stakeholders that would be involved in managing the scenario should it occur. These stakeholders are the Västra Götaland county administrative board, the Municipality of Ale, Göteborg Kretslopp och Vatten, and Bohus Rescue Services Association. Additional interviews have been conducted with various subject experts who hold no operational responsibility for the interviewed stakeholders.

Scenario

The landslide occurs on 20 November, a Thursday morning.

Geographic location

The scenario plays out at Älvängen, along the Göta River, about 15 kilometres north of Kungälv. Älvängen's industrial area lies next to the Göta River, where industrial activities have taken place since the early 1900s. Today the area is mostly used for small-scale industries and offices. There are contaminants present in the soil from the years of industrial activity. Downstream are both a waterworks and a raw water intake supplying half a million people in Gothenburg and the surrounding municipalities with drinking water.

9. The delegation includes representatives from MSB, the National Board of Housing, Building and Planning, the Swedish Transport Administration, the Swedish Maritime Administration, the Swedish Environmental Protection Agency, the Swedish Agency for Marine and Water Management, the Geological Survey of Sweden, and the Swedish Meteorological and Hydrological Institute (SMHI).

Sequence of events

It has been raining unusually heavily over large parts of western Sweden during the autumn and the flow of the Göta River has been high for a while.

At 08:00 SOS Alarm receives several alerts that the E45 highway and railway have collapsed and that a commuter train full of morning commuters has overturned and slid down towards the river. The land around the carriages has broken up into floes and several carriages look about to slide down into the river. SOS Alarm also receives several calls from people who cannot get out of the industrial premises. The premises are partially destroyed and have moved up to 25 metres towards the river, which in turn seems to have been dammed as a result.

When the rescue services arrive they quickly understand that a major landslide has occurred. A stretch of approximately 700 metres has been affected by the landslide, whose rear edge is largely made up of the E45 highway, with the foot of the landslide by the Göta River. This makes the width of the landslide around 200 metres. Almost immediately it is clear that the ground contaminants at the industrial area have collapsed into the river and threaten the supply of drinking water downstream.

Capability analysis

The rescue services will initially focus on saving lives by evacuating everyone in the landslide area, including searching the train carriages and collapsed buildings. There are proven ways for the rescue services to start rescue efforts quickly and to scale up the organisation, such as through co-operation between the various municipal rescue services. Any ambiguities regarding responsibility for the rescue services at such a major incident can be clarified by the county administrative board assuming responsibility for the rescue services (pursuant to Chapter 4, § 33 of the Ordinance (2003:789) on protection against accidents). This does not happen automatically but after an assessment of the situation and in consultation with, for instance, the local rescue services.

Furthermore, on the basis of their respective geographical areas of responsibility (local and regional), both the Municipality of Åle and the county administrative board of Västra Götaland are responsible for initiating co-operation between the affected stakeholders – such as between neighbouring municipalities – and for organising voluntary organisations. With the support of these stakeholders, MSB will establish an overall national status report. The status report provides a cross-sectoral description of the impact, the disaster-management measures, and the need for co-ordination. It is intended to strengthen joint stakeholder action at the national level and may serve as a basis for prioritisation. The status report is created by stakeholders sharing their information and assessment regarding the situation on the basis of their area of responsibility. MSB is able to assist at a national level – e.g. by holding co-operation conferences to share status reports between the stakeholders affected, co-ordinating information, brokering resources, and providing expert support on landslides, etc. MSB's support to stakeholders in terms of communication includes publishing questions and answers at krisinformation.se to meet the public need for information.

In addition, the authority may arrange national reinforcements, as well as request additional international reinforcements. Other reinforcements that may be relevant include helicopters (in co-operation with the Swedish Police Authority, the Swedish Armed Forces, and private stakeholders), rescue swimmers for saving people in the river (in co-operation with the Swedish Coast Guard), and divers (in co-operation with the Greater Gothenburg rescue services association or the Swedish Coast Guard, the Swedish Armed Forces, the Swedish Police Authority, or private stakeholders).

Even if the incident in question is extensive and requires more resources and co-operation than normal, it is likely that the rescue services and other blue-light services are capable of locating and evacuating the injured. A limiting factor is whether there are sufficient resources to complete this within a reasonable amount of time. Reinforcements in the form of operational personnel (as well as search and rescue dogs) from MSB's advanced search and rescue team SWIFT/USAR, and equipment such as water treatment plants and flooding equipment, are also available for national operations. One shortcoming is that there are currently no procedures for how the resources from SWIFT/USAR should be called upon and used nationally. Another limiting and very specific factor in how quickly an evacuation can be conducted is that cranes for lifting any collapsed homes and train carriages will not be able to enter the landslide area initially due to the high level of risk involved. This problem reflects the need for getting geotechnical expertise to the landslide area quickly in order to assess whether the rescue services can enter and with what equipment. Since there are currently no on-call geotechnical experts available 24/7 at either SGI or the Västra Götaland county administrative board, the rescue services are not guaranteed rapid access to expert support in geotechnical assessments.

The Municipality of Åle, the Västra Götaland county administrative board, and MSB will be responsible for ensuring there is sufficient co-operation between stakeholders – both those affected by the incident and those needed to respond to the incident – that sufficient resources reach the accident site, and that the public are kept informed. An incident of the magnitude in the scenario will place a heavy burden on the rescue services and the municipal disaster organisation, even if procedures are in place and have been practised and the organisation has been trained. Consequently, in the long term, the county administrative board will need to support the municipality with additional staff and with disaster communications. It should be emphasised, however, that the county administrative board's resources are also limited. Experience from similar incidents and exercises shows that there is limited sustainability in temporary disaster structures and organisations created at the time of an incident, especially in terms of human resources.

Impact assessment

Human life and health

The landslide causes a number of deaths, as a train is pulled down by the landslide. Furthermore there are a few people in the landslide area, who risk death or injury. MSB estimates that up to 100 people may have been killed and up to 200 people may have been injured by the landslide.

There is a heightened risk of disease if the quality of the drinking water decreases for a large number of people. It is unclear how many people are affected, but approximately 700,000 people are in the danger zone.

Society's functionality

The scenario involves a large number of injuries and medical care will be impacted in the short term. If there is insufficient medical care capacity in the region, patients may have to be transferred to other hospitals and resources may have to be brought to the region. Some operations and other planned activities may need to be postponed.

The threat of pollution to the supply of drinking water from the landslide is so high that it will take a long time before the raw water intake can be opened again, possibly several months. It is uncertain how long backup water-supply

sources will last, and therefore it is uncertain how great the need for emergency water is. The scenario could cause water shortages in several municipalities, including Gothenburg.

Water shortages, including possible leaks due to lower pipe pressure and poorer raw water quality, have a substantial impact on health and medical care as well as on social care. Overall, water shortages place an increased burden on health and medical care, as well as on the social services in relation to distributing water and to outreach activities targeting people who do not usually require support.

Sea, road, and rail traffic is affected by the landslide and its impact, although the extent of this depends on how long recovery efforts take. There are several railways and roads in the area that allow traffic to be diverted, and the Swedish Transport Administration Region Väst states that freight and passenger services can operate. However, alternative public transport may be difficult to put in place to begin with.

No industrial activity can take place in Älvängen's industrial area until the area has recovered. It is unclear how long it will take for the area to recover, and there is no guarantee that industries will choose to return to Älvängen. Trade and industry, including tourism, are also affected by the disruption caused by the landslide to road, rail, and river transport, as well as to the supply of drinking water. This results in disruption to production and consequently a loss of production.

Economic values and the environment

The direct costs of the landslide are estimated to amount to as much as SEK 10 billion. This includes the cost of restoring the road, railway, and industrial area, the clean-up, and the rescue response.

MSB considers the total economic impact to be incalculable. It will far exceed the SEK 10 billion from the direct impact, based primarily on the cost of the loss of production.

Several Natura 2000 areas are located next to the river, which may be affected by the pollutants from the industrial area. Short-term disruption to fish stocks will occur, while a loss of biodiversity can be expected in the longer term.

Democracy, rule of law, and human rights and freedoms

The psychosocial impact is difficult to assess, but the scenario involves a large number of individuals who are exposed to various forms of stress. Coping with anxiety is an additional task for municipal social care services, voluntary organisations, and religious communities.

Hoarding behaviours can occur in the event of a water shortage. In the worst case, the distribution of emergency water can become a subject of controversy with social unrest as a result.

Currently no authority has a mandate to determine how different parts of the water distribution system should be prioritised. This can be compared with electricity distribution, which can be regulated through Styrel. Controversial decisions may at worst cause anxiety.

Confidence in the authorities may be badly affected when it becomes known that the risks of Älvängen's industrial area have been known for several years without measures being taken to prevent the occurrence of an accident.

Probability

Although it is possible to identify areas in which geotechnical conditions and past incidents indicate a high risk of landslides, there is no method to accurately predict when a landslide will occur.

The probability of landslides is considerably higher in some parts of the country than in others, and this increases in conjunction with snowmelt, the thawing of frozen ground, and periods of heavy rainfall.

SGI has assessed the probability of landslides in Älvängen's industrial area as 4 to 5 on a five-point scale, depending on where in the area measurements have been carried out. Climate change forms the basis of this assessment. The Göta River is one of the areas in the country where the risk of landslides is expected to increase due to climate change, albeit to different degrees for different stretches.

Uncertainty assessment

Although several landslides of this magnitude have occurred in Sweden and there is a high level of theoretical knowledge of landslides, considerable uncertainties in the assessments remain. The number of deaths or injuries is highly uncertain. It depends largely on how the train dragged down with the landslide is positioned within the landslide mass.

How long backup water supply sources will last is difficult to assess with any certainty. The impact of water shortages is incalculable and therefore highly uncertain. However, what is certain is that the impact will be large regardless of the method of assessment.

Sensitivity analysis

How serious the impact of a landslide is depends on its size and especially on where the landslide occurs and what is in the landslide area and surrounding area. For instance, should the landslide not reach the Göta River, there would not be the water problem which is the most serious impact.

If the Göta River were to be dammed it would potentially complicate the scenario considerably. This could mean that draining from Lake Vänern would have to be reduced, which in turn would lead to flooding around Lake Vänern. Moreover, damming would increase the risk of landslides downstream as the power of the water to retain the banks would decrease. Damming also means that the mass of water has to be released, either intentionally or by dam failure. In both cases a flood wave would occur, which in turn increases the landslide risk downstream.

A ship could be in the channel when the landslide occurs. This increases the workload of the rescue services and most likely makes rescue efforts in the river even more difficult.

Electricity and sewerage facilities are located a few hundred metres upstream from the landslide area. Should these be included in the scenario, there is a risk of several homes being without power and of being unable to close off drains, which further complicates clean-up efforts.

The time of year has an effect due to the outside temperature, for instance, which in turn can affect the number of deaths, as the rescue response can take a long time. The time of year also affects the risk of low water levels in backup water-supply sources. Staffing levels are generally lower in the summer as well.

1.2.3 Capability to be developed

Preventative measures

Landslides are natural geological processes that cannot be completely avoided. Preventing the natural event "mudslide" is about continuing to develop knowledge about vulnerable areas through analyses and assessments in the form of municipal and regional risk and vulnerability analyses, as well as the mapping that MSB is currently carrying out and which has also been carried out by SGI. In many cases, the risk is known and well documented. The 2013 risk and vulnerability analysis from the county administrative board of Västra Götaland covers, for example, the risks in the event of a landslide in Älvängen's industrial area, including disruptions that may arise within the supply of drinking water. It is important that a good level of knowledge is maintained of the country's other sensitive areas.

Based on this knowledge, the stakeholders responsible need to take preventative measures to reduce their vulnerability and avoid the major impact of landslides. One such measure is avoiding the construction of housing, infrastructure, and essential services in these areas, such as through the regulation of planning processes. The extent to which this is done is down to the individual municipalities. Many houses and a lot of Swedish infrastructure were built before these surveys were carried out and are already located in risk areas. In these cases, there are several methods for preventing or reducing the risk of landslides, such as excavation, backfilling, flattening, piling, sheet-piling, and erosion protection to mitigate the landslide risk.

MSB administers funds from a special appropriation in the state budget: appropriation *2:2 Preventative measures against landslides and other natural disasters*. The appropriation for 2014 amounted to nearly SEK 25 million. Municipalities can apply for funding from the appropriation for preventative measures. Municipalities are currently submitting applications to MSB for considerably more than SEK 25 million.

Response (preparatory) measures

One of the problems with all disasters, mudslides included, is that the temporary structures created to respond to each incident have insufficient experience and the people involved have had insufficient exercise. To ensure that the relevant stakeholders' disaster management structures work as effectively as possible, experience from past incidents and exercises must be utilised, such as with regard to sustaining human resources for the municipal organisation, for instance. Updated analyses and recurrent exercises are essential to keep this knowledge alive. That said, the situation in the area affected by this scenario is relatively good. The risk of landslides is known in Västra Götaland and specifically for Älvängen's industrial area, and the county administrative board has worked actively on both training and exercises for several years. Several of the stakeholders involved have practised a major landslide exercise in the Göta River valley. A similar landslide scenario at Älvängen's industrial area was also analysed by the Västra Götaland county administrative board within the framework of their regional risk and vulnerability analysis in 2013.

There are currently no general guidelines for how rescue efforts in a landslide area will work. Instead, geotechnical assessments have to be conducted individually for each landslide area. When a landslide occurs, it is important to get geotechnical expertise to the landslide area quickly in order to assess whether the landslide area can be accessed and with what equipment. On the basis of their needs, municipalities should establish agreements with local geotechnical experts in order to secure access to 24/7 advice and mobilisation. The government has decided that SGI will have an on-call official (OCO) from 1 December 2015.

One current measure is MSB's work to develop a policy document for how SWIFT/USAR will be used as a national resource. MSB has also identified the need to disseminate the information that this resource is available.

1.3 Flooding

Sweden is affected more or less regularly by major flooding. This report splits floods rather simply into two different types. The first type is fluvial flooding. This is flooding from watercourses and lakes as a result of a major injection of water from precipitation or snowmelt into the run-off area of a watercourse. In this type of flooding, zones along the shoreline/banks are flooded. The second type of flooding is pluvial flooding and is a result of intense, short-term precipitation in a relatively small geographical area. Other causes of flooding include high winds, air pressure in the atmosphere, earthquakes under the sea that affect sea levels in coastal areas, ice plugs in watercourses, and dam failures.

In most cases, flooding in Sweden has occurred around watercourses and lakes. One study has found that the majority of floods in the period 1901–2010 occurred solely along watercourses and lakes.

There is considerable knowledge about flooding of watercourses and lakes. Since 1998, the flood risk for watercourses and lakes has been mapped within the framework of MSB's general flood mapping, which shows the areas along lakes and watercourses where there is a risk of flooding once water levels reach a certain point. The maps show the spread of the 100-year flood and the estimated maximum flood level for each watercourse. The purpose of flood mapping is to act as a basis for the municipalities' overall physical planning, and as a basis for work with municipal action plans. Mapping can also support the rescue services' overall planning of efforts.

In 2007, the EU adopted a directive on flood risk[10] which regulates flood management. In Sweden the directive has been implemented in Regulation 2009:956 on flood risks, and in MSB's stipulations (MSBFS 2013:1) on the county administrative boards' plans for managing flood risks.

Since 2012 the flood maps have been updated with elevation data and new climate-adjusted floods. Additionally, detailed flood maps have been produced within the framework of the flood regulation and for the areas where an extensive potential flood impact has been identified.

There are a number of areas (18 identified areas) in Sweden where there is a considerable threat of flooding and where the impact of a flood could be serious. Examples of such areas are Uppsala, Lake Mälaren, and the Göta River.

Lake Mälaren is the third largest lake in Sweden, and together with Lake Hjälmaren it has a run-off area stretching from the Bergslagen region in the west to Norrström in central Stockholm in the east. Around 2.5 million people live around Lake Mälaren, and the surrounding infrastructure is well developed. Most of the surrounding municipalities also use the lake for their supply of drinking water.

Lake Mälaren has been regulated since the early 1900s in order to prevent excessively high or low water levels. High tides do cause problems, however. In the late autumn of 2000, the highest water level since the start of regulation was measured in Lake Mälaren. The floods affected holiday home areas and large areas of farmland. The floods even threatened several essential social services. The Gamla Stan subway station in Stockholm also came close to being flooded.

10. Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks.

The floods in 2000 showed that there is a serious risk that the supply tunnel systems for water, electricity, telecommunications, and district heating beneath Stockholm could be affected. It is expected that this would have a serious impact at a local, regional, and national level as the loss of infrastructure could result in disruption to critical infrastructure.

Flooding caused by extreme short-term rainfall has not been as common as fluvial flooding, although in recent years there have been several examples of torrential rain occurring. Torrential rain can affect the entire landscape and urban areas; even those that have never had to consider the flooding of watercourses or lakes in their planning. Knowledge of the water's route to low points in the terrain is required in order to describe the sequence of events in advance and predict the impact of heavy and short-term rain.

No scenario analysis with a focus on flooding has yet been conducted within the framework of the national risk and capability assessment.

1.4 Storm

Powerful storms have rolled in over Sweden many times over the centuries. In the 2000s alone, more than ten major storms have already occurred: Gudrun (2005), Per (2007), Berit, the Advent storm, and Dagmar (all 2011), Simone, Hilde, Sven, and Ivar (all 2013). Gudrun is often cited as the worst storm in living memory, resulting in 18 deaths and 75 million cubic metres of forest felled, equivalent to around three annual fellings in Götaland, and just under a year's felling in Sweden as a whole. Almost 30,000 km of cabling was damaged – nine per cent so badly that it needed complete reconstruction. Up to 730,000 electricity customers were without power when the situation was at its worst.[11] Over 250,000 subscribers had no working phone line immediately after the storm. In some places, virtually all essential social services were briefly unavailable.

Storms are more common in the south of Sweden than in the north. Strong winds are strongest and most frequent in the mountains, but because few people live there, there is limited critical infrastructure and rarely any impact. It is worse along the coast, especially the west coast.

The term "ice storm" is used when wind and rain or snow result in the build-up of ice on the ground, buildings, and power lines. In February 1921 large areas of western Sweden and the Swedish midlands were affected by an ice storm incident in which wet snow quickly froze due to a rapidly falling temperature. This meant that the whole landscape was covered by a layer of ice 4.5 cm thick. In addition to this incident in 1921, SMHI indicates that similar situations have occurred in Sweden on five other documented occasions.

No scenario analysis with a focus on storms has yet been conducted within the framework of the national risk and capability assessment.

1.5 Heat-wave

There is no universally accepted definition of a heat-wave. In the scenario below, MSB has adopted SMHI's definition of a heat-wave as "at least five consecutive days when the maximum daily temperature exceeds 25°C."

11. Swedish Energy Agency, *Stormen Gudrun – Vad kan vi lära av naturkatastrofen 2005?* (*Storm Gudrun – what can we learn from the 2005 natural disaster?*), ET 2006:2.

Internationally, heat-waves that are geographically very widespread have occurred on several occasions in recent times. One example is the heat-wave that affected large parts of Australia in 2013. It was widespread, and during the heat-wave almost the entire continent was affected at some point by temperatures that were extreme for the time of year.

The extensive heat-waves in Europe in 2003 and in Russia in 2010 were also very widespread geographically.

1.5.1 Responsibilities

Responsibility for preventative efforts are difficult to specify as a heat-wave has a widespread impact on both individuals and social activities. Measures to reduce vulnerability could, for instance, involve the stakeholders responsible for infrastructure working to make such infrastructure less sensitive to extreme heat.

As an expert authority in matters such as meteorology, SMHI is tasked with warning of weather which may pose a danger to the public and essential social services.

The following stakeholders will likely have a special role during a heat-wave: county councils, the National Board of Health and Welfare (the need for medical care), the Public Health Agency of Sweden, the county administrative boards, and the MSB (support for co-operation, development of a status report, and co-ordination of information). However, several other stakeholders – from the individual to the public administration – will be affected and will be responsible for managing the impact of the incident.

1.5.2 Scenario analysis: Heat-wave

The national risk assessment of 2012 conducted an analysis of the *prolonged heat-wave scenario*. The analysis of 2012 was based in part on a workshop held in collaboration with the Örebro county administrative board with representatives from the municipalities of Örebro and Hallsberg (security and water), the Närke fire service, Länstrafiken Mälardalen, the Swedish Police Authority, the Swedish Transport Administration, Swedish State Railways (SJ), the cargo transportation company Green Cargo, and the bus company Nobina. The scenario had previously been agreed with representatives from SMHI, the Swedish Transport Administration, FOI, and MSB.

In 2013, an in-depth analysis of the same scenario was carried out in order to reduce uncertainties in the assessments made in the 2012 analysis. The analysis is based on the same scenario used in 2012 and builds on the analysis and assessments made then. The in-depth analysis is mainly based on literature studies and interviews with experts in the field.

Scenario

The scenario takes place in August. The ground is dry during the summer.

Geographic location

The scenario takes place in Örebro county, mainly in the Region of Örebro-Hallsberg.

Sequence of events

Unseasonably high daytime temperatures in multiple locations were already being recorded in May, and it continues to be hot at times in June. There is remarkably little rain and by the middle of July the ground is dry and groundwater levels are low. The entire summer is unusually hot, but the heat-wave culminates in a two-week period in early August when the maximum temperature is around 30–35 degrees and does not drop below 18 degrees at night. Temperatures reach 38 degrees on two occasions, and the nighttime temperature is at most just over 24 degrees. See Figure 3 for the maximum and minimum temperatures during the period 1–15 August.

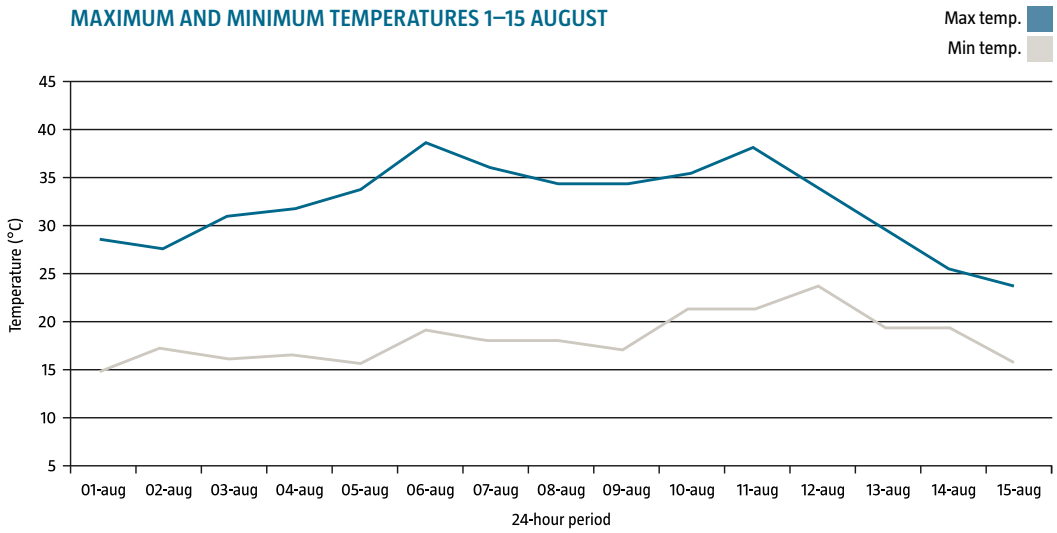


Figure 3: Maximum and minimum temperatures for each 24-hour period between 1–15 August, measured at SMHI's station in Örebro.

Capability analysis

A very important aspect of responding to the worst possible impact of a heat-wave is that the public administration and experts, such as authorities including SMHI, the Public Health Agency of Sweden, the National Board of Health and Welfare, and MSB, inform the public about the heat-wave, its development, effects, and how best to protect oneself. Today there are effective channels for such information, including the websites of these authorities, or MSB's website krisinformation.se which collates and provides links to this relevant information. In an initial phase, SMHI has tried and tested procedures to warn of a heat-wave, with a Class 1 warning if the forecast shows that the maximum temperature will be at least 30 degrees on three consecutive days, and a Class 2 warning if the forecast shows that the period of maximum temperatures of at least 30 degrees will continue longer than five days and/or the maximum temperature is at least 33 degrees on three consecutive days.

A crucial factor is how this information reaches the most vulnerable groups during a heat-wave, such as elderly people living alone. Relatives and home care personnel have a great responsibility. Stakeholders in health care and social care have a responsibility to ensure that vulnerable people receive care if needed. This can be a major task that requires considerable resources.

The capability to manage the impact is also largely about ensuring that critical infrastructure and key supplies of goods and services can be maintained. The distribution of water to key activities may need to be prioritised – e.g. if the availability of water is reduced dramatically. There are currently no procedures for this. Decisions on priorities, and the grounds on which they are made, must be communicated to the relevant stakeholders.

Impact assessment

Human life and health

Experience shows that deaths resulting from heat occur especially among the elderly, the mentally ill, people with dementia, and people with COPD and other lung diseases. Infants are also considered vulnerable. The number of people in the Örebro-Hallsberg region who die from the heat is estimated to be between 30–100, based on previous model calculations of the, rather uncertain, health impact of heat-waves. The number of people with serious or very serious injuries as a result of e.g. heat-related fires, traffic accidents, food poisoning, and health problems is estimated to be between 25–100.

Society's functionality

A general conclusion is that a heat-wave of this magnitude would have an impact across a range of activities, including rail transport, and the supply of electricity, food and drinking water.

Rail transport would be affected by a variety of minor problems. Heat distortion[12], interference in signalling and power supply, and broken overhead lines can result in reduced speeds or services being suspended. Likewise, the indirect impact of fighting fires along the railway and ongoing repairs may affect the capability to run services normally. Longer power outages over a wide area may require newer trains to be evacuated onto the railway as the air conditioning will not work and windows cannot be opened. Overall, these problems may cause problems with traffic flow and result in prolonged delays.

There are also components related to the power supply that could be adversely affected by a prolonged heat-wave. These include long suspended power lines that can expand in the heat and hang low enough to come into contact with ground vegetation. If the ground is also dry, this can cause fires. Transformers appear to be a sensitive component in a heat-wave. Smaller transformers lacking forced cooling are most vulnerable. Higher temperatures may also result in overloading of transformers, primarily those located indoors (this mainly concerns stations at the regional grid level). The Swedish Energy Agency states that higher temperatures result in increased wear on wires and cables, resulting in a lower transmission capacity. Additionally, overloading and power outages can occur, affecting local grids and regional grids on lower voltage levels.

The impact of a widespread power outage during a heat-wave would be problematic. This is because of the dependency on electricity for maintaining various services as well as for cooling. Cooling in places where there are many people (e.g. trains), the cooling of food, and the cooling of technical equipment (control systems, IT, server rooms, telecommunications) are especially problematic. Heat-waves also cause competition for staff and equipment as cooling systems in a variety of businesses encounter problems when trying to function at the same time.

12. Heat distortion is the local buckling or lateral displacement of railway track due to solar heat.

A prolonged heat-wave places considerable pressure on the cold chain with regard to food supplies. The greatest danger lies in the combined effect of many small problems that gradually raise the temperature of the goods, the reduction of the units' cooling capacity in the heat, and temperature controls throughout the entire chain not always working. Problems within the cold chain for food distribution can also have an adverse effect on the range of food available.

In this scenario, the heat-wave was preceded by a dry period that caused groundwater levels to fall and a subsequent water shortage. At the same time, the demand for water (e.g.for drinking water and irrigation) is expected to increase during a prolonged heat-wave, which further increases the pressure on groundwater resources. These problems can primarily be considered to apply to individual water supplies, although they also apply to shared facilities in the event of low capacity.

Economic values and the environment

Financial losses result from e.g. the loss of production within areas such as food production and forestry. Indirect impact such as the reduced capacity of and disruption to the power supply, IT systems, freight and passenger transport also has associated costs.

In addition there are management and repair costs. The economic impact is likely to be significant, but the scope of the damage caused by the scenario is deemed to be too unclear to allow any quantitative cost estimate.

Cost estimates for heat-waves have been made in other countries, but there is considerable uncertainty in the results. The 2003 heat-wave in the UK is estimated to have cost approximately GBP 318 million, of which GBP 41 million is attributable to the health-care sector. In two areas, tourism and trade, the heat-wave contributed to increased financial income.

Democracy, and human rights and freedoms

A heat-wave could result in a loss of confidence in public institutions in Sweden. Health and social care could be particularly vulnerable as trust in these activities can be assumed to be relatively low on the basis of negative media coverage, not least elderly care, whose users constitute a particularly hard-hit group in terms of health in this scenario.

Probability

A more extensive heat-wave is likely to occur in Sweden, although it need not have the exact same temperature data or be preceded by a dry spring as in this scenario. A heat-wave can also follow a wet spring, which has a somewhat different impact as the probability of vegetation fires, for instance, is lower.

Climate change is expected to increase the frequency and duration of heat-waves in the future. There have been a greater number of summers with heat-waves in Sweden in the last 20 years (1991–2010) compared with the 30 years before that (1960–1990).

Uncertainty assessment

There is deemed to be a high level of uncertainty in the impact assessment as a whole. The analysis showed that the scenario has large variations in uncertainty. There is a wealth of statistics for the health-care sector, indicating a lower level of uncertainty in the assessment, while there is a high level of uncertainty regarding the heat-wave's impact on power, IT, and communications systems, as well as regarding its economic impact.

Sensitivity analysis

A geographically more widespread heat-wave would have a more serious impact. A heat-wave with a scope that affects, for example, several major cities or densely populated regions would have a considerable effect on the overall impact.

The average daily temperature is not necessarily of vital importance to the impact on people and society during a heat-wave. Rather, it is the nature of the heat-wave and how the temperature varies during the day that affects the impact.

1.5.3 Capability to be developed

Preventative measures

Heat-waves cannot be prevented. However, the problems that may arise in connection with these phenomena can be worked on to a certain extent. Perhaps one of the most important measures is increasing the knowledge of the fact that heat-waves – in line with climate change – will increase in frequency and scope. Increased knowledge can contribute to the public's increased awareness of risks, and especially to ensuring better protection for various critical infrastructure that at susceptible to heat.

The capability to communicate is important during an incident. This requires that premises housing IT and telecommunication equipment have a power supply and are cooled. One way to contribute to the latter is to site large server rooms in areas with little risk of heat-waves or in rock shelters.

Similarly, control equipment for railway traffic (signalling, power supply, and telecommunications) should be designed and located so that it is not knocked out or affected by heat-waves. Generally, society must become better at learning about how infrastructure and different technical components are affected by heat. For example, the problem of heat distortion needs to be taken into account in laying railway lines.

Response (preparatory) measures

When a heat-wave is forecast, it is important that SMHI – as it does today – has the capability to both predict and issue relevant warnings. There is currently a procedure whereby, in the event of a class 2 or 3 warning, MSB invites relevant stakeholders to a co-operation conference. It remains important that at this stage, before the actual heat-wave, decisions can be made that create the basis for active and informed decision-making. This basis is made up of a collection of status reports that are continually developed and updated. If possible, however, decisions need to be made at an earlier stage by way of co-operation initiatives on pre-determined priorities, such as the distribution of water to critical infrastructure. These established priorities currently do not exist, with the exception of electricity priorities in the event of an electricity shortage (Styrel). Where there are priorities – with or without a pre-determined order – procedures need to be in place to communicate decisions and the bases for prioritisation to the relevant stakeholders.

Stakeholders and the public need to have knowledge of how heat can affect health, food, and water for drinking and bathing, as well as of how to act to reduce the impact. Dinsäkerhet.se, krisinformation.se, and similar websites are important tools for informing and communicating knowledge. An important focus is reaching those individuals and groups that are most vulnerable during such an incident.

The cooling of critical components, equipment, and facilities – such as transformers, trains, food, and technical equipment (control systems, IT, server rooms, telecommunications) – should be prioritised. There is currently a shortage of staff in this area. There should be contingency plans in place for the repair of cooling equipment.

There needs to be the capacity to provide and receive assistance from neighbouring counties in the event of a heat-wave.

1.6 Forest and vegetation fire

Around 3,000 to 4,000 fires in forests and on land occur in Sweden each year. Sweden experiences summers with extensive forest fires once or twice per decade. The most common causes of forest fires is normally human activities such as logging, campfires, and playing with fire. Natural phenomena such as lightning can also result in forest fires. The risk of forest fires and vegetation fires varies from region to region in Sweden. Some parts of the country suffer from drought more than others, while differences in vegetation makes the fires behave differently.

The overall risk of fire in forests and on land is governed by both weather conditions and the type of vegetation. A tool that can be used by everyone to get an idea of the current fire risk is the fire risk forecasts available on MSB's website[13]. The forecasts are also available on the app "BRANDRISK Ute". Municipalities and county administrative boards may use the information to decide on fire restrictions or other fire protection measures. Public and private stakeholders can also get guidance on whether it is appropriate to light fires.

A major forest fire occurred in Västmanland during the summer of 2014. The fire developed into the largest and most difficult to control forest fire in modern times in Sweden. One person was killed and two were seriously injured as a result of the fire. A total of 71 buildings were damaged or destroyed and about 1,000 people and nearly 2,000 domestic animals were evacuated. The area affected four municipalities in the county of Västmanland. Efforts involved a large number of organisations, authorities, and people from many parts of the country, as well as international resources.

Several evaluations of the forest fire have been made, and MSB is currently working on a government assignment to create the conditions for better disaster preparedness on the basis of experiences from the management of the forest fire.

No scenario analysis with a focus on forest fires and vegetation fires has yet been conducted within the framework of the national risk and capability assessment.

1.7 Infectious diseases

Diseases are an ever-present risk to humans, animals, and plants. A pandemic is a worldwide epidemic that affects large segments of the world's population, such as outbreaks of influenza. There are also diseases called zoonoses that are transmitted between animals and people. An outbreak of a contagious animal disease is called an epizootic.

13. https://www.msb.se/brandriskprognoser

The impact from the outbreak of a zoonotic disease varies depending on the nature of the zoonosis, whether it is a known or unknown infection, and how big the outbreak is. Approximately 60 per cent of new or re-emerging infections are zoonoses and many of Sweden's and the world's most serious diseases are zoonoses. The impact of a new zoonotic disease is often much greater than that of a known disease, because society and infectious disease control are less prepared. The impact in regions that have been affected early on in recent years in a new zoonotic disease outbreak, such as of avian flu or Ebola, has been considerable. This is primarily because such an incident can lead to restricted movement across borders and considerable concern among the population.

In this report "influenza pandemic" refers to the worldwide spread of a type-A virus – the virus that caused the four pandemics that have affected mankind since the 1900s: Spanish flu (1918–1920), Asian flu (1957–1958), the Hong Kong flu (1968–1969), and most recently A(H1N1)pdm09, the so-called swine flu (2009).

Pandemics have differed in terms of their severity, the age groups affected, and their impact on society. Influenza affects older people more, although this group have often shown a degree of protection against new strains during pandemics due to having had similar infections earlier in life. Therefore, it has primarily been children, young people, and middle-aged adults who have fallen ill.

Spanish flu is the pandemic that has had the most serious impact to date. Around a third of the world's population fell ill and 20–50 million died. In Sweden, the official number of fatilities was just over 34,000. Secondary diseases caused by bacteria were the most common cause of death. At that time, no antibiotic had been discovered and developed into a drug.

1.7.1 Responsibilities

Sweden has a national pandemic group, which co-ordinates contingency efforts and convenes during or in the event of an imminent outbreak of a pandemic. Linked to the national pandemic group is a network of communicators and information managers from the relevant authorities. Since 1 July 2015, the Public Health Agency of Sweden has been responsible for the national co-ordination of infection protection matters and is convened to the network.

Together with international stakeholders, the Public Health Agency of Sweden has the task of developing knowledge about virus infectivity, identifying the groups which are at risk of infection, identifying which severe illness may occur upon infection, and carrying out risk assessments. This includes an assessment of the likely severity of the influenza pandemic, which requires data "real-time" – e.g. about sickness rates. The National Board of Health and Welfare is updating its health-care recommendations and is developing strategies for the management of various types of pandemic scenario based on severity. The Public Health Agency of Sweden is responsible for laboratory activities and is developing new methods of analysis, as well as using existing systems which, among other things, monitor the spread and extent of the number of sick. Many other stakeholders are involved in the event of an incident, either in managing the incident or by being indirectly affected by its impact. As part of the response, MSB can, among other things, provide support for co-operation, the development of a status report, and the co-ordination of information.

1.7.2 Scenario analysis: Pandemic flu

The analysis was conducted in 2013 and is based on literature studies and a workshop with representatives from the Swedish Work Environment Authority, the Swedish Social Security Agency, the Municipality of Hjo, the Swedish Board of Agriculture, the Municipality of Karlsborg, Lund University's Centre for Risk Analysis and Management (LUCRAM), the Swedish Medical Products Agency, the Västra Götaland county administrative board, the National Criminal Police (RKP), the Institute of Infection Protection (SMI)[14], the National Board of Health and Welfare, the Swedish National Veterinary Institute (SVA), the Swedish Defence Research Agency (FOI), the Swedish National Road and Transport Research Institute (VTI), and the Region of Västra Götaland. MSB took part in the workshop on the basis of the authority's operational assignments.

The scenario had previously been agreed with representatives from the National Board of Health and Welfare, the Institute for Infection Protection, the Swedish National Veterinary Institute, the Swedish Medical Products Agency, FOI, MSB, the Swedish Work Environment Authority, Uppsala University and Uppsala University Hospital, the Crisis Management Coordination Secretariat of the Prime Minister's Office, the Swedish National Food Agency, and Sörmland County Council.

Scenario

The scenario begins in June and lasts for around eight months. The number of influenza cases in Sweden peaks during two weeks in November.

Geographic location

The pandemic begins abroad and spreads across the globe, one hemisphere at a time. All of Sweden is affected, although the impact varies between different parts of the country and at different times during the pandemic.

Sequence of events

In June, there are reports of a possible epidemic in country X, possible caused by an aggressive influenza virus. Approximately two weeks after the first outbreak in country X, the first case is identified in Sweden. Initially, there is no vaccine against the virus.

During the two-week peak of the outbreak, around 15 per cent of Sweden's population are ill. Approximately 70 per cent of Sweden's population have been vaccinated within approximately 10 weeks (week 52) of mass vaccination beginning. The number of cases steadily falls, but it is estimated that as many as 30 per cent of Sweden's population (2.85 million people) have been ill between June and December. A total of 2 per cent of the population (around 190,000 people) have been seriously ill. The number of deaths is still unclear.

On 27 February (week 9 of the following year) the WHO declares that the world is now in a post-pandemic period.

14. As of 1 January 2014, the Public Health Agency of Sweden took over the tasks of the Institute of Infection Protection.

Capability analysis

Vaccination and care of the sick is an implicit part of the scenario. The following discussion is about the need for knowledge and resources that have to be in place, as well as the structure and procedures for management, co-operation, and communication that must work from day one in order to effectively respond to the incident's overall impact.

Management

Priority issues are key for all stakeholders during the pandemic. The pandemic will likely require decisions to be made at the highest national level. This includes, among other things, prioritising resources and vaccination strategies. For H1N1, each county council drafted vaccination priority arrangements.

Alternative strategies are needed for how to act in various types of pandemics. It should be possible to make a decision early on regarding the strategy to be used. The decision should, if necessary, be re-evaluated, because there must be room to adapt to changes during the course of the pandemic. If the authorities are unable to adapt measures to the situation, this may mean that they do not have the effect required, leading to more people unnecessarily falling ill and dying.

Clear procedures must be in place for the stakeholder making decisions regarding, for instance, the distribution of vaccines and antiviral drugs, and the basis on which priorities are made. The evaluation made by the National Board of Health and Welfare and MSB from the flu of 2009 revealed that the conditions for how the national stock of antiviral drugs should be used needed to be clarified in terms of who or what decides on the distribution of these drugs to critical infrastructure, and of the bases on which this decision is made. The basis on which the National Board of Health and Welfare plans the use of stand-by drugs includes plans for how antiviral drugs and vaccines will be distributed and managed so that the strategies of the national pandemic plan can be followed. Other factors that may also affect the course of the pandemic include decisions to close schools[15], places of work, public transport, and similar activities, and whether this can help to limit the spread of infection.

Co-operation

MSB should start monitoring the course of events and establish and continually update an overall national status report with cross-sectoral descriptions of the impact, disaster management measures, and co-ordination requirements. In the acute stage, MSB will call an additional information co-ordination conference to agree on planned information measures and what may need to be co-ordinated. Information is shared through krisinformation.se, both online and through social media, with links being provided to information from other authorities.

The capability to generate continuous and reliable status reports is important. There is, however, a risk that the need for continuously updated status reports at the regional and national level could overload stakeholders. If co-operation between the stakeholders during a pandemic fails, unnecessary concern and uncertainties regarding the measures to be taken may arise and ultimately result in the wrong measures being taken. MSB can, if necessary, relieve the stakeholders by assisting with co-ordination.

15. According to the 2012 pandemic plan, closing schools is partway effective, although schools have to be closed early on and children's contact outside school has to be limited.

Communication

Co-ordinated and clear information is crucial for avoiding confusion and mixed messages. The national pandemic group and the related information managers' network will have a key role during an incident. Krisinformation.se will also play an important role by helping to give the public a coherent message from stakeholders. Communication emerged as a major challenge in the joint evaluation of the 2009 pandemic by MSB and the National Board of Health and Welfare. The division of responsibilities between the central authorities and county councils regarding communication issues needs to be made clear.

The authorities' communication skills are also essential to help to maintain the population's willingness to be vaccinated, which is decisive to the outcome of a pandemic.

Knowledge and skills

Being able to carry out laboratory analyses quickly is key to being able to classify the disease and assess whether it is a danger to the public. This means that the disease is covered by the provisions of the Act on Protection against Infection Diseases (2004:168), which, for instance, makes it possible to identify cases of the disease and limit its spread early on.

Resources

Key to the development of the pandemic is how quickly a vaccine is made available and when a large-scale vaccination programme can be implemented.

Health-care resources, which are already strained, will be hit hard in this scenario. Influenza A(H1N1) primarily affected children and young adults, and the spread of the pandemic and its impact were less severe than was feared. Sweden had low mortality rates compared to most other countries, but the strain on the health-care sector was considerable despite variations between county councils. The scenario analysed here is much more serious and could involve a bigger strain on health services.

Other countries may ask Sweden for hospital beds and vice versa. Such exchanges took place during the 2009 pandemic flu – e.g. between ECMO[16] places. The 2012 study on international assistance had the task of identifying the circumstances and obstacles that may affect Sweden's capability to receive international assistance during disasters and serious incidents during peacetime, such as major natural disasters, nuclear accidents, and pandemics[17]. The study concluded that Sweden's current civil contingency system is well positioned for receiving international assistance during disasters and major incidents during peacetime. The situation could be improved in some areas. The study makes a number of suggestions as to how Sweden's capability to receive international assistance can be developed.

Impact assessment

Human life and health

MSB estimates that the scenario could result in a total of between 8,000 and 10,000 deaths.

16. Extracorporeal Membrane Oxygenation. Meaning oxygenation outside the body.
17. SOU, *Sveriges möjligheter att ta emot internationellt stöd vid kriser och allvarliga händelser i fredstid*, (*Sweden's capability to receive international assistance during crisis events and major incidents in peacetime*), 2012.

During the peak of the pandemic (when 15 per cent of the population are ill, according to the scenario), it is estimated that around 225,000 are off work due to their either being ill themselves or looking after a sick child. This corresponds to 7.5 per cent of the total workforce.

Society's functionality

The situation within the health and medical care sector quickly becomes untenable during the pandemic. There is already a shortage of some medical skills and resources. This includes shortfalls at some intensive care facilities. The health and medical care sector is currently lean with regard to supplies and services, in accordance with the "just-in-time" model.

The current total health-care capacity is approximately 5,000 to 10,000 patients per week. The need for some specialised treatments, such as ECMO, is likely to increase, although there are only a few ECMO machines in Sweden. The scenario assumes that as many as 190,000 people will become seriously ill during a period of a few months (the majority during the peak). Such a development would be catastrophic for the health and medical care sector.

Many businesses will be affected by a shortage of staff, including transport (which is labour intensive), financial services (such as cash management and cash transportation), the food sector, municipal technical support (such as water production and waste management), and the energy sector, with a large socio-economic cost as a result.

Economic values and the environment

Major costs will be incurred in the health-care sector and health-care-related activities, such as laboratory activities and countermeasures such as vaccination. The greatest socio-economic costs are likely to result from lost productivity caused by sick leave.

The evaluation of the 2009–2010 pandemic estimated the economic impact in Sweden to be about SEK 6 billion. This assessment includes both direct and indirect costs, such as vaccination, absenteeism due to the vaccination, absenteeism due to side effects (although not side effects for those affected by narcolepsy), inpatient care, intensive care, ECMO, antiviral drugs, laboratory costs, sick leave, and death.

Democracy, rule of law, and human rights and freedoms

A pandemic is likely to result in rumours being spread, and many people will avoid crowded places. It is difficult to know how people will behave during a serious pandemic. However, research suggests that looting and violence do not increase during a disaster. People help each other instead.

How public stakeholders respond to the pandemic greatly affects public confidence in them. If different messages are circulated – and worse still, contradictory messages – this undermines confidence in the public stakeholders. Social media can be an important channel for the authorities to reach out to the public. Clear procedures for how to reach out to citizens who do not have Swedish as their mother tongue are also important. There is an ongoing debate about the side effects of the last pandemic vaccine. Among other things, there are studies that show a link between the Pandemrix vaccine and narcolepsy. Some responsible authorities have been heavily criticised for the mass vaccination that took place, but it is unclear whether and how this links to a possible lack of trust in public institutions.

Probability

New pandemics are inevitable, and the question is not whether but when the next pandemic will occur, which virus it is, and exactly what social impact it will have. There is no reliable scientific estimate of when the next pandemic will occur. Experts often disagree on the likelihood of extreme events, and this case is no exception.

Four pandemics have occurred in the last century. None of pandemics has been the same. They have differed in terms of their severity, the age groups affected, and their impact on society.

Uncertainty assessment

There is a low level of uncertainty regarding whether the scenario will lead to a large number of fatalities or people getting seriously ill during the pandemic. However, there is a high level of uncertainty regarding exactly how many people will die or fall ill. The same applies to the assessments of the economic impact.

Sensitivity analysis

There are parameters that affect how big the impact of a pandemic will be. The severity of the pandemic depends on how aggressive the virus is and how many people die of the disease. A crucial factor for succeeding in reducing the spread of infection is how quickly the vaccine can be made available and how willing the population are to be vaccinated. In this scenario it is assumed that the vaccine is made available four months after the WHO distributes the pandemic strain to producers. In principle this means that the most effective countermeasure for reducing the spread of infection does not have a significant effect on the outcome.

Other factors that may lead to a more serious scenario include multiple peaks in the number of cases, antiviral drugs being unavailable due to increased resistance to antivirals, antibiotic resistance having become more widespread and thereby complicating the treatment of subsequent bacterial diseases, and the simultaneous occurrence of an epizootic (animal disease).

1.7.3 Capability to be developed

Preventing a pandemic would be difficult in our current globalised world with its large flows of people across borders. The most effective and implementable measure – vaccination – is limited by the short period of time available between the discovery of an outbreak and when people in Sweden will start being affected. People cannot be vaccinated in advance against all possible pandemics.

If vaccination is to be effective, it must be implemented more quickly than in this scenario (four months from the outbreak until the vaccine reaches the market, and a further ten weeks before the vaccination programme is complete). The practical means for achieving this are uncertain.

Another important factor is the willingness of the population to be vaccinated. This was relatively high during the AH1N1 outbreak in 2009. But it may not be the same for a future outbreak. The population's confidence in the recommendations of society and experts – in this case the need for vaccination – is vital.

With AH1N1 in mind, there are currently relatively good preparations overall for responding to a pandemic. This applies to e.g. planning, prepared structures and procedures for co-operation and communication, and a good knowledge among stakeholders of pandemics and their potential impact. This capability must be kept up to date.

Similarly, it is inevitable that a lot of critical infrastructure, particularly the health and medical care sector, will be hard hit. As a rule, these functions are designed to work optimally in normal situations and have no redundancy in terms of human resources for a disaster. Regarding the health and medical care sector, even in normal situations there is a lack of skills and resources, such as intensive care beds. The situation in the event of a serious pandemic could be catastrophic. The capability to give and receive international assistance – e.g. in terms of special equipment such as ECMO machines – may to some extent alleviate this shortage. Planning and procedures for such an exchange must be maintained.

1.8 Antibiotic resistance

Antibiotic resistance is a global challenge. The growth and spread of resistant bacteria is continuing at a relatively slow and stealthy pace. Although this is difficult to stop or limit. With the increasing use of antibiotics it has been found that more strains of bacteria are becoming resistant to these drugs.

Infections can be treated as long as there are alternative antibiotics, but resistance is now so extensive that there will soon be no antibiotics left to treat certain types of bacteria with certain types of resistance. Our capability to fight disease in humans and animals is being significantly reduced. Today's modern health care depends on antibiotics for treatment and prophylaxis. This is becoming increasingly difficult to carry out. Specifically, this means that certain urinary tract infections and blood infections are becoming more difficult to treat, and more people could die as a result of hard-to-treat infections.

The situation in Sweden is good, with a low prevalence of resistant bacteria from an international perspective. The situation regarding antibiotic resistance is generally better in northern Europe than in southern Europe, according to reports by the European Centre for Disease Prevention and Control (ECDC) outlining the situation in Europe.[18] Based on ECDC reports, it is possible to see trends over time. A general trend is that antibiotic resistance is slowly increasing. In Sweden, we can be concerned that the situation may get worse with time and become more similar to the situation in some southern European countries. The Public Health Agency of Sweden is warning in particular of the development of $ESBL_{CARBA}$, a resistance mechanism mainly affecting gastrointestinal bacteria such as *E.coli*. Few cases have been discovered in Sweden so far, but this rise is taking place rapidly.[19] Bacteria with $ESBL_{CARBA}$ can break down carbapenems, the kind of antibiotics usually considered as a last resort in infections with resistant bacteria.

Sweden has a long tradition of working to fight antibiotic resistance and preventing the spread of infection. In 1986 Sweden became the first country in the world to ban the use of antibiotics to promote growth in animals, and has been a leader in EU efforts which in 1998 resulted in a strict limitation of the use of growth-promoting antibiotics, followed by their complete ban in 2006. The Swedish government is the main funder of the network ReAct, which is a global, independent network that promotes measures to combat antibiotic resistance. The organisation's international secretariat is based at Uppsala University.[20]

18. European Centre for Disease Prevention and Control (ECDC), 2014, *Antimicrobial resistance surveillance in Europe 2013*.
19. The Public Health Agency of Sweden and the National Veterinary Institute, Swedres-Svarm 2014 – *Consumption of antibiotics and occurrence of antibiotic resistance in Sweden*, 2015.
20. http://www.reactgroup.org

In 2012, the National Board of Health and Welfare was tasked by the government to initiate and take responsibility for a national co-operation mechanism, to develop a cross-sectoral action plan for co-ordinated efforts to combat antibiotic resistance and nosocomial infections, and to establish a comprehensive communications strategy for the field in partnership with the Swedish Board of Agriculture and within the framework of the Swedish *Strategy for co-ordinated efforts to combat antibiotic resistance and nosocomial diseases*[21]. This assignment runs until 2017 and is reported to the Government Offices of Sweden on an annual basis. In conjunction with the Public Health Agency of Sweden taking over responsibility for infection protection from the National Board of Health and Welfare on 1 July 2015, this assignment was transferred to the Public Health Agency of Sweden.

A specific task of the co-operation mechanism and the stakeholders participating in the national co-operation group has been the development of a communication strategy and action plan for Swedish efforts to combat antibiotic resistance and nosocomial infections. The communication strategy[22] was published in December 2014 and the action plan[23] in March 2015. The action plan will form the basis for the new national strategy for antibiotic resistance that the government and the Government Offices of Sweden are currently working on.

Within the framework of the national risk and capability assessment, in 2015 MSB will analyse a scenario addressing the increased spread of multi-resistant gastrointestinal bacteria. The analysis focuses on the $ESBL_{CARBA}$ resistance mechanism and what this might mean for Swedish disaster preparedness.

Antibiotic resistance and its challenges have also been highlighted within the framework of the co-operation agreement between Sweden and the US Department of Homeland Security, in which both MSB and the Public Health Agency of Sweden are taking part.

1.9 Attacks by pest insects (plant pests)

Plant pests include various diseases, insects, and other parasites that attack and damage plants. The impact of the introduction or spread of serious plant pests in Sweden is that both their establishment and control have a negative environmental impact – e.g. on forests and biodiversity – as well as leading to nutrient leaching. The forestry industry could be the worst affected.

The Swedish Board of Agriculture has pointed to two incidents in the EU in recent years. In 2007 and 2009 there were outbreaks of the insect "Asian Longicorn" in the Netherlands. The insect attacks trees and there is a risk of its being imported into Sweden with nursery plants.

The pine wood nematode (PWN) attack conifers, primarily different species of pine, and is now established in Portugal. It is spread via wood from the areas where it is present that have not been heat treated, such as pallets and other wooden packaging. PWN was discovered in Sweden in 2008 in wooden packaging from Portugal, although the nematode has not established itself in the wild. The Swedish Board of Agriculture considers the risk of nematodes from packaging and bark reaching growing conifers in Sweden to be low, but states that the impact would be serious if this were to occur. Control methods are gradually improving, but the estimated cost of eradication is close to SEK 1 billion for an

21. Government Bill (2005/06:50) *Strategy for co-ordinated efforts to combat antibiotic resistance and nosocomial diseases*.
22. The National Board of Health and Welfare and the Swedish Board of Agriculture, *Communication strategy for antibiotic resistance and nosocomial infections*, 2014.
23. The National Board of Health and Welfare and the Swedish Board of Agriculture, *Action plan against antibiotic resistance and nosocomial infections – Basis for the authorities' continued efforts*, 2015.

attack over a 10 kilometre radius. The impact of the damage from the nematode is considered to be greatest for the forestry industry. This is where the greatest intervention is required to control it.

1.10 Solar storm

"Solar storm" is a collective name for powerful bursts of radiation and plasma from the sun. Solar storms occur in active areas that are first seen as dark spots, known as sunspots. The presence of several of these areas is a sign of a higher level of solar activity. There is roughly an eleven-year cycle of activity. In some cases these outbreaks reach Earth. What happens then is that the electric field from the solar storm induces different voltage levels at the earth's surface, generating currents in the earth's crust, which in turn cause problems primarily in the power grid but also in telecommunications networks, railways, and pipelines.

Some examples of solar storms that have had an impact on society are the Carrington storm in 1859, the September storm in 1909, the May storm in 1921, the August storm in 1972, the Hydro-Quebec storm in 1989, the Bastille storm in 2000, and the Halloween storm in 2003. The Carrington storm is considered to be one of the most powerful solar storms of modern times. Its effects were reported from the US, Canada, UK, Finland, and India. The primary disruption and damage was noticed in telegraph systems. During the May storm of 1921, infrastructure was badly affected in several countries, primarily telecommunications infrastructure. The storm also caused a fire at a telephone exchange in Karlstad, Sweden.

Several of the solar storms caused local disruption to power networks around the world, with northern Europe being the worst affected. The Halloween storm is one such example, with 50,000 homes left without power in Malmö, Sweden.

1.10.1 Responsibility

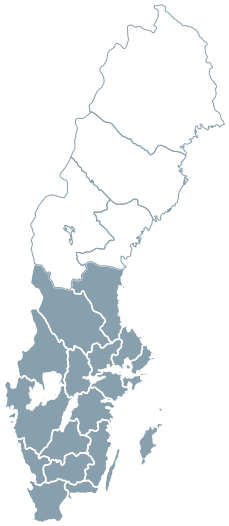
Svenska kraftnät is the authority responsible for the core grid and is one of the primary stakeholders in efforts to prevent and respond to power outages that may be caused by a solar storm. Business stakeholders (including municipal companies) have a corresponding responsibility for the regional and local power grids. The Swedish Energy Agency is the administrative authority and has overall responsibility for ensuring the safe supply of energy, while the Swedish Post and Telecom Authority has corresponding responsibility for telecommunications networks. The infrastructure is owned and maintained, however, by private stakeholders. The Swedish Transport Administration is responsible for the railway network. Many more stakeholders are involved in the event of an incident, either in managing the incident or by being indirectly affected by its impact. As part of the management, MSB can, among other things, provide support for co-operation, the development of a status report, and the co-ordination of information.

1.10.2 Scenario analysis: Solar storm

The scenario was developed and analysed in 2014. The specific variables of the scenario were agreed by the Swedish Institute of Space Physics and the Department of Space and Plasma Physics at the KTH Royal Institute of Technology. Svenska kraftnät contributed to content based on its role as the authority responsible for electricity systems and for the operation and management of the core grid.

Empirical data for the analysis was collected by way of interviews with stakeholders in civil contingency. Interviews were conducted at the premises of the Swedish Post and Telecom Authority, the Civil Aviation Administration, Vattenfall,

and Svenska kraftnät. In addition, phone interviews were conducted with Oskarshamn nuclear power plant, the Swedish Transport Administration, and SJ. Furthermore, a number of Swedish authorities' risk and vulnerability analyses have been used as a basis for the assessment of the impact on the national values of protection. Other countries' risk assessments have also been part of the empirical data collected.



Scenario

The scenario plays out during a winter of heavy snowfall and cold temperatures.

Geographic location

Götaland, Svealand, and Norrland south of and on the same latitude as Söderhamn.

Sequence of events

On 15 January, Sweden is experiencing a cold winter with lots of snow. There is an ongoing cold snap and temperatures of around -15°C are expected to last for another week.

Early in the morning (Swedish time) on 22 January, NASA's satellites detect a powerful solar storm outbreak. Over the next few days, there are major disruptions to satellite signals and a total loss of short-wave radio communications that last for several hours at a time across the whole daylight side of the earth.

Late in the evening of 22 January, Svenska kraftnät states that it has detected major problems in both the core and regional grids. Several transformers and cables are automatically disconnected. All bar five core grid transformers can be reconnected.

Core grid cables around Gävle are tripped out to such an extent and with such speed that core grid transmission from northern Sweden cannot be stabilised. Exactly one minute after the first core grid cables around Gävle are tripped out, a voltage collapse occurs, resulting in a power outage in Sweden south of the 61st parallel (the same latitude as Söderhamn).

On the morning of 23 January, Svenska kraftnät reports that for as long as the geomagnetic storm is in progress, the disconnected parts of the core grid cannot be restarted, as the cables and transformer are tripping out when restart attempts are made.

Initially there will be a three-day power outage throughout the whole of central and southern Sweden, as the solar storm prevents the restarting of the power grid for the first two days.

Capability analysis

Under the conditions of this scenario, the solar storm will result in a power outage that lasts at least three days. Only after the solar storm subsides can repairs to the damaged cables commence and the disconnected parts of the core grid be restarted.

During such an extensive and prolonged power outage, the start-up of the power grid will take longer than the time it takes for Svenska kraftnät to make its part of the system ready for start-up. This is because the companies contracted to work on the start-up and repairs have contracts with both Svenska kraftnät and

regional and local power grid companies. In the event of major disruption, there is uncertainty regarding how the available human resources should be prioritised between the different stakeholders. To some extent staff can be borrowed from other countries, but this can pose practical difficulties since other countries may also be affected by the solar storm, not to mention different working methods, languages, nomenclature, and unfamiliarity with Swedish equipment and repair methods. This contributes to uncertainty regarding whether the regional grid is in a position to commence start-up once Svenska kraftnät is ready to start the grid. During this situation, MSB should prepare documentation providing a basis for decisions based on a national prioritisation of resources.

Svenska kraftnät has a stock of equipment for emergency repairs. In co-operation with Vattenfall Eldistribution, E.ON, and ABB, Svenska kraftnät has also developed mobile substations that can act as emergency facilities and replace broken regional grid stations. These may also be affected by the solar storm, however.

For all critical infrastructure in the affected area, plans, structures, resources, and procedures must be in place if they are to function during power outages as well. The availability of backup power is a key part of this. The national availability of backup power equipment and the sustainability of the backup power supply is currently highly deficient. This would likely result in many stakeholders in society not being able to conduct their activities.

Impact assessment

Human life and health

No one is expected to die either from the solar storm itself or as a result of the immediate impact on critical infrastructure. However, many people will be indirectly affected as systems for the distribution of heat, water, and food will be affected by disruption and stoppages. The impact may also mean that life-sustaining medical care stops working and may result in staff shortages in the health and medical care sector, as well as in the social care sector. The emergency services may be overstretched and struggle to deal with all incoming calls and automated calls from security alarms that are no longer working. The worst affected are those who are already sick; the elderly; and small children with a greater dependence on heating, water, and food, although other people in the community risk being adversely affected as basic needs cannot be met.

Society's functionality

The impact of this scenario will initially involve a power outage throughout the whole of central and southern Sweden for at least three days. More than 8 million people live in this area. After this period there will continue to be sporadic power outages for a longer period, especially in the areas where the transformers have tripped out. The scenario will have a major impact on critical infrastructure that depends on electricity. There may be a knock-on impact – e.g. on transport, electronic communications, health and medical care, social care, and municipal technical support.

Economic values and the environment

The scenario involves a considerable economic impact for all of society, ranging from the loss of power, the loss of production, and transportation losses. MSB estimates that the economic impact of damaged infrastructure such as satellites, pipelines, telecommunication base stations, and railway transformers could amount to more than SEK 50 billion.

Democracy, rule of law, and human rights and freedoms

If basic needs cannot be met, it can lead to people feeling powerless and result in high levels of anxiety about the situation. This scenario involves a considerable need for information, guidance, and support. Problems in communicating and interacting with citizens can cause a lack of trust in those responsible for dealing with the disaster, from the highest level of the government to grid companies and the authorities responsible for power distribution.

Probability

The areas mostvulnerable to solar storms lie within the geomagnetic latitudes 50 and 65 degrees north over the North American continent, and within the geomagnetic latitudes 60 and 75 degrees north over the European continent. Sweden lies within this area.

Solar activity generally follows an eleven-year cycle. Strong solar storms can break out at any time during a cycle. Some of the strongest to date have occurred during weak cycles, such as the 1921 storm and the Carrington storm of 1859. Researchers say that the strength and duration of a solar storm determine its impact on infrastructure, provided that the solar storm reaches Earth. This means that less powerful solar storms, if prolonged, can have a considerable impact on Earth.

Uncertainty assessment

In this analysis, the greatest uncertainty is the indirect impact of the scenario and on how people will react. There is no doubt that all critical infrastructure depends on electricity. It is very difficult to assess how many people could die, or how people could react to the situation or the lack of information. There are also uncertainties regarding how solar storms can damage various transformers and how powerful a storm must be to do so.

Describing and assessing the full economic impact is also very difficult. Costs arise through a variety of consequences, such as a loss of power, a loss of production, and transport losses.

Sensitivity analysis

This scenario occurs during the winter when temperatures are below freezing. The impact of a loss of heating would be less if the incident occurred when there were warmer temperatures.

In this scenario, the core grid is split at the latitude of Söderhamn, resulting in over 8 million people being affected by widespread power outages. If the geographical extent was smaller, the impact would be smaller as fewer people and less critical infrastructure would be affected. This scenario only affects Sweden, but since Sweden's electricity grids are connected to those of other countries affected by the same solar storm, this will have a major impact on cross-border co-operation and co-ordination and the allocation of shared resources, and it may cause conflicts regarding the production of transformers.

The impact would be worse if more than five transformers were tripped out. Should the power outage last for more than a week, the impact would be far worse, not least economically in terms of producing and installing new transformers.

1.10.3 Capability to be developed

Preventative measures

Solar storms cannot be prevented, but it is possible to make the systems affected by solar storms less vulnerable. For example, some of the most vulnerable existing transformers in the power grid could be replaced by other, less sensitive models. Most of the transformers in the core grid are already of this type. In cases where transformers cannot be replaced, they can be better protected.

Response (preparatory) measures

There has not been any authority or organisation in Sweden that is responsible for the monitoring and early warning of solar storms. From 2015, SMHI will offer a solar storm warning service. The earlier a solar storm can be detected, the better the opportunity to prepare stakeholders and businesses and to take preparatory measures. Sweden does not currently have the capability of issuing long-range forecasts of whether and when a solar storm may occur. Relatively reliable predictions can be supplied only a few hours before a solar storm reaches Earth. Not even then is there any certainty that it will have any major impact.

Research to improve forecasts and warnings requires better support. The results of this research need to be applied in the civil contingency system.

The immediate impact of a solar storm is widespread power outages. These can be alleviated with the help of backup power. MSB assesses that there is a lack of availability of backup power equipment and a lack of sustainability of the backup power supply within critical infrastructure. This is primarily due to uncertainty regarding the supply of diesel for the backup power equipment in the event of prolonged disruptions to the power supply. Although supplier agreements are in place, it is unclear whether it is possible to ensure access to diesel in practice. Procedures for the counties' stakeholders to test their backup power, maintenance, and start-up of backup power vary. MSB assesses that exercises relating to the supply of backup power have been neglected in the counties.

Within the framework of the risk and vulnerability analysis, several authorities have identified the need for backup power. Together with the Swedish National Electrical Safety Board, the Swedish Energy Agency, the Swedish Post and Telecom Authority, and the Swedish Civil Contingencies Agency, the Swedish National Food Agency has produced guidance for the management of backup power processes, which highlights all the steps from a requirements analysis through to care and maintenance. This guidance was presented during five theme days in 2015 and can support efforts to improve capabilities in terms of the access to and sustainability of backup power.[24]

As mentioned in the analysis, the start-up of the power grids will be delayed by the lack of emergency personnel for start-up and repairs. The need to prioritise resources to different parts of the core grid, regional grids, and local grids must be investigated further, as must the possibility of quickly borrowing staff from abroad in practice.

24. *Guidance for managing the backup power process*, MSB784 – December 2014.

Major accidents

2. Major accidents

"Major accidents" refers to incidents caused by humans but without any antagonistic intent, or caused by technical faults, a lack of maintenance, or faulty design.

This category has been divided into four subcategories: transport accidents, extensive fires, emissions of hazardous substances, and other large-scale accidents such as dam failures.

2.1 Transport accidents

A transport accident can have a major impact on society, especially if it occurs in the wrong place at the wrong time, such as during the transport of dangerous goods. Every single accident, big or small, can have a devastating impact in terms of human suffering.

Fortunately, the number of deaths due to road accidents in Sweden has decreased, although the number of vehicles on the roads has multiplied. However, a number of major traffic accidents involving buses have occurred in recent years. In an accident between Östhammar and Uppsala in 2007, six people died and 52 were injured. In 2003, six people died when a bus overturned near Fagersta. In an accident in 2006 near Arboga, nine people died and 42 were injured, 24 of whom were seriously injured. On 15 August 1988, there was a bus accident in Måbödal, Norway, where the party was a group of school children and parents from Kista, Sweden on a class trip to Norway. The accident claimed 16 fatalities, the majority of which were children.

The most recent major railway accident was in Lerum in 1987, in which nine people died and 130 were injured. In a tram accident in Gothenburg in 1992, 13 people died and 29 were injured. The most recent serious crash in Swedish commercial aviation took place in 2001 at Linate airport near Milan. In that incident, 118 people died when an SAS aeroplane collided with another aeroplane on the runway.

The *M/S Estonia* incident on 28 September 1994 is the vicinity's single largest maritime disaster in the modern era. Many of the passengers were Swedish citizens. 501 of the 552 Swedes who were on board lost their lives. Only 137 of the total 989 people on board could be saved.

2.2 Extensive fires

In this section "extensive fires" refers to different types of building fire, and to extensive fires in infrastructure such as road tunnels, mines, ships, and underground railway systems.

Building fires include fires in public buildings, homes, industrial buildings, and other buildings. In Sweden, the most common known cause of building fires in public buildings is arson; in residences the most common known cause is chimney fires, while technical faults are the most common known cause of fires in industrial and other buildings. Fires in buildings lead mainly to personal injury and damage to property.

The building fires that have claimed the most fatalities in recent decades in Sweden is the discotheque fire in Gothenburg in October 1998, in which 63 young people aged between 12 and 20 died and around 50 were seriously injured, and the fire in the Stadshotellet hotel in Borås in 1978, in which 20 people died, many of them young, and 50 were injured. The fire in Gothenburg was caused by arson

and spread from the stairwell into the venue. The fire in Borås was caused by smoking; it began in a wastepaper basket and the smoke spread quickly in the hotel. In both instances it was difficult to evacuate the premises.

An extensive fire in a road tunnel can result in a prolonged fire, impact on vital societal functions, and cause injuries to many people. Fires in road tunnels can be caused by overheating coupled with leaks or electrical faults, such as fires that start in an engine compartment or collisions. The fire in Årsta tunnel in Stockholm in June 2008 is one such example. No one died, but the tunnel was closed to traffic for a few hours and had to be evacuated due to thick smoke. The fire was started by a truck that caught fire. A similar scenario occurred in the Oslofjord tunnel in Norway in June 2011, in which two people suffered serious smoke inhalation injuries.

An extensive fire in Stockholm's metro system is a risk that can lead to major loss of life and thereby affect an organisation's operations as well as confidence in and use of the metro. No such major accident has occurred in Sweden, although there have been some small fires at metro stations and on trains.

Fires can also break out in all types of vessel, with a potentially serious impact on human life and health, economic values, and the environment. Few major fire-related incidents involving ships have occurred in the Swedish maritime rescue region. Some cases stand out, however, such as in Sweden the disastrous fire on the *Scandinavian Star* passenger ferry in 1990, in which 159 people lost their lives.

2.2.1 Responsibilities

The responsibility to prevent fires – fire protection – in terms of extensive fires (and all other fires) ultimately rests with the owner of the property or the operator of the business at risk. The municipality (rescue services) is generally a supervisory body. As an expert authority, MSB is responsible for improving fire safety in society, including by conducting research, issuing rules and standards, and supporting individual capabilities. Regulations and supervision may vary depending on the property or business in question. There is an international regulatory framework for ships, which comes into effect in Sweden through regulations issued by the Swedish Maritime Administration.

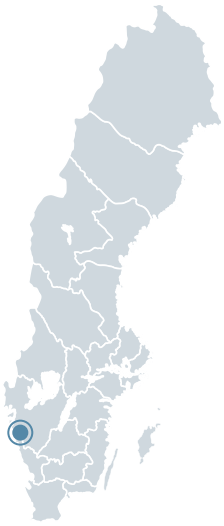
During a fire, the rescue services have a major responsibility for managing the work. The rescue services and other stakeholders involved depend on the nature of the incident.

In the event of a serious fire on a ship – see scenario below – the ship's own rescue services have primary responsibility for fighting the fire and dealing with its impact. Stakeholders who assist with the rest of the rescue response provide assistance and support based on the type of assistance requested and required by the ship's personnel. The Swedish Maritime Administration's Joint Rescue Coordination Centre (JRCC), which is based in Gothenburg, is responsible for the operational management and co-ordinates the response. The centre calls out the (emergency) units from the Swedish Coast Guard, the Swedish Maritime Administration, the rescue services, and the Swedish Sea Rescue Society, for example. JRCC's role is then to co-ordinate and lead the rescue response and monitor what all the stakeholders involved are doing. MSB can assist in supporting co-operation (implementation of co-operation conferences), developing situation overviews, and co-ordinating information.

Other stakeholders that may be involved in the incident and its aftermath are neighbouring municipalities (treatment of passengers), the state, the shipping company, and insurance companies (compensation issues).

2.2.2 Scenario analysis: Fire on cruise ship

The analysis was conducted in 2012 and is largely based on an expert workshop arranged by the County Administrative Board of Västra Götaland with representatives of the Swedish Coast Guard, the Swedish Transport Agency, Tjörn Municipality (rescue services), the Swedish Maritime Administration including JRCC, the PKMC (Prehospital and Disaster Medical Centre), the Port of Gothenburg, and the Greater Gothenburg rescue services. The scenario had previously been agreed with the Swedish Maritime Administration and the FOI research institute.[25]



Scenario

It is a clear but windy Friday night between 14 and 15 December.

Geographic location

The scenario takes place in Gothenburg and its surroundings.

Sequence of events

The cruise ship *M/S Freya* is on its way from Southampton (United Kingdom) to Gothenburg. With a length of 294 m, width of 32.3 m, and a draught of 7.9 m, it is one of the largest cruise ships to call at Swedish ports.

On this night the ship is fully booked with a total of 3,503 people on board (2,250 passengers and 1,253 crew members). The composition of the passengers is varied: the elderly and middle-aged, families with children and adolescents.

A violent fire breaks out on board with very rapid progression. The fire starts in the engine room. The safety system, consisting of carbon dioxide and sprinklers, is activated but has only a marginal effect on the fire. The crew members attempt to extinguish the fire themselves but do not bring it under control. In this scenario, the ship's operating function and electrical equipment stop working. The communications equipment and emergency lighting still function.

The smoke is highly toxic and panic breaks out among the passengers. The decision is made to evacuate the ship. Approximately two-thirds of the passengers gather at the muster stations on deck. There is great confusion as to where the other passengers are and a rumour spreads that many have died.

Capability analysis

Response and co-operation

The incident will place a large burden on the stakeholders involved in the acute stage of the incident. Despite this, the incident is unlikely to lead to any overload of these organisations, especially if the co-operation with neighbouring countries regarding resources works as it should.

The rescue response's initial task is primarily life-saving and secondly firefighting. This entails searching the ship and the surrounding waters before controlling and extinguishing the fire. The standard rescue organisation on board the ship and the crew's expertise, education, and experience are crucial to a successful response.

25. The development of this scenario has drawn inspiration from real incidents and upcoming visits by cruise ships to the Port of Gothenburg. The course of the fire is based on the fire in the Norwegian ship *The Hurtigruten* (2011).

The rest of the rescue response will follow the ship crew's wishes regarding what kind of assistance they want and need. Resources from the rescue response can also serve to relieve the crew.

JRCC will ensure that the (emergency) units are called out from organisations such as the Swedish Coast Guard, the Swedish Maritime Administration, the rescue services, and the Swedish Sea Rescue Society. Its role is then to co-ordinate and lead the rescue response and monitor what all the stakeholders involved are doing. At first this is a Swedish operation, even if international merchant ships may help. After the initial phase, co-operation with neighbouring countries begins, as management of the incident requires a lot of resources.

According to the scenario description, the decision is made to evacuate the ship. The goal then is for the regular crew on board to evacuate the ship within the hour. However, it is worth emphasising that in many cases it is good to postpone evacuation by lifeboat for as long as possible, provided this does not place more passengers' lives at risk. Evacuating offshore is dangerous, difficult, and time-consuming. Furthermore, weather conditions may also hamper the evacuation process. Rescue helicopters are not a viable alternative. A helicopter can normally only evacuate six people at a time. It would take four days to evacuate everyone off the ship by helicopter.

Communication

There is a strong need for information. The fire will be global news, and the stakeholders must be aware that a lot of international media will be present. Spokespeople with a good knowledge of languages will be needed. The management of the incident and international perceptions of the incident are important. How the disaster is perceived is often governed by the media. One of the conditions for successful media management is that those involved provide the media with consistent information and only comment on their field.

There will be non-Swedes on board the ship. If any of them is injured or dies, it is important to inform the relevant embassies, for example.

Resources

Based on a study of the preparatory emergency plans for this type of response, Sweden has relatively strong resources from a European perspective. Nowadays, for example, there are rescue teams, known as Maritime Incident Response Group, or MIRG, that specialise in smoke and chemical diving for lifesaving responses on ships.

There will be a shortage of hospital beds. Patients can be sent to their home county (which is paid for by the home county council). If the patient's home county is abroad, travel insurance pays for this. Patients can be sent directly to Norway and Denmark, where the patients are then registered (the police are responsible for registration) and the information is sent to JRCC in Sweden, which informs the health service. There are twelve beds for specialist burn treatment in Sweden (in Linköping and Uppsala). Patients with burn injuries usually go to a regular hospital first and are then transported further for specialist treatment. Once the patients are stable, they can be sent to other countries in Europe which have a co-operation agreement with Sweden. Smoke inhalation injuries can be treated in Sweden.

Impact assessment

Even though the responses are effective, the incident inevitably has a serious impact on the basis of several of the national values of protection.

Human life and health
It is estimated that 30 to 500 people will die as a direct result of the scenario. Most of the fatalities are due to smoke inhalation injuries (carbon monoxide poisoning) in the cabins or on the way out to the muster stations. Over 2,500 people are estimated to be seriously injured or traumatised and have long-term psychological injuries due to the incident.

It is also conceivable that injuries are only discovered in retrospect or that a couple of people die prematurely due to exposure to carcinogens during the incident. However, such injuries are usually caused by exposure over a longer period of time.

Society's functionality
This scenario would place major strains on the stakeholders involved in the response of the incident, especially in the short term, and on their capability to respond to any other simultaneous incidents (not discussed in the scenario). Otherwise the scenario has only a marginal effect on the society's functionality.

Economic values and the environment
The incident's economic impact can entail costs running to several billion SEK, including costs for damage to the ship, which itself is worth several billion SEK.

The scenario is also expected to result in major costs for the municipality (in this instance the City of Gothenburg), costs which can be partially claimed back from the state, the responsible ship-owner, and its insurance company in retrospect. The municipality is responsible for taking care of the people who come into the country. They decide whether the unharmed passengers should be given shelter in schools, hotels, or elsewhere. Showers, toilets, and canteens are needed.

The fall in production – in this case a loss of income – is a major financial loss. The shipping company will not be able to use the ship to transport passengers for a long time. The loss of income is estimated to amount to several million SEK.

Direct financial losses would also arise as a result of claims and fines. Claims for damages would run to many millions of Swedish kronor and the legal processes would be lengthy.

The administration and restoration costs would include e.g. costs for the rescue response. This would be a major response at a relatively low cost in the context.

The incident will also require psychologists, which may mean that additional psychologists need to be employed. The municipality also misses out on income from the tourists that the cruise ship would have brought to the city.

The incident is estimated to have a limited impact on nature and the environment.

Democracy, rule of law, and human rights and freedoms
After the incident the situation will be critically assessed, which could result in several people in decision-making roles having to leave their posts. This is very rare in Sweden, but there are instances where it has happened. As a result of the *Estonia* disaster, the director of shipping had to resign. If it emerges that the stakeholders involved in the management of the incident did not co-operate well, many will face criticism. Another example is if an evaluation reveals that inspections have not been conducted regularly. In those cases there would be strong criticism and pressure from society.

As a result of the incident, there could also be calls for new regulations or laws. There may be such calls even if it emerges that rules were in place but not followed during the incident.

The incident could result in some people initially becoming anxious and avoiding travel by boat or ferry in the short term after the incident. No looting of the ship is expected because the ship will be guarded.

Widespread rumours via social media are expected while the incident is ongoing and over the following days. This will then scale down as time passes, but may continue for a long time – e.g. through various conspiracy theories.

The incident is estimated to have only a marginal effect on Sweden's international reputation. International media will contact the Swedish authorities almost immediately and ask critical questions regarding Swedish maritime safety. Sweden's image could be strengthened in the longer term through a good response to the incident.

Probability

The course of events in the scenario is deemed to be reasonable, given that a fire begins.

Nowadays there are fewer engine-room fires. After the fire on the *M/S Prinsessan Ragnhild* in 1999, all passenger ships have to be equipped with local-application fire-fighting systems (additional protection for specific flammable surfaces as a complement to the rest of the ship's fire protection), which means many engine-room fires are extinguished at an early stage.

According to statistics from the database of SjöOlycksSystemet (SOS – the Sea Casualty System), an average of 124,000 ships call at Swedish ports every year. The number of cruise ships has increased substantially in recent years and new records are set every year. Around 70 cruise ships arrived at Gothenburg in 2012. The corresponding figure for Stockholm was around 300. The majority of ships arrives during the summer, which means that the probability of fire is lower during the winter months.

During the period 1992–2010, 133 incidents of fire on board were registered in Sweden's economic zone, of which 11 were classified as "serious" or "sinking". Six of these incidents occurred at sea and five when the ship was laid up or moored at a dock.

Uncertainty assessment

The greatest uncertainty is in the assessments of the magnitude of the economic impact and the number of fatalities and seriously injured or sick people, as well as the extent and effects of rumours.

Sensitivity analysis

There are several circumstances that would result in a more serious scenario. For example, worse weather conditions would hamper the evacuation considerably. Furthermore, problems could arise should the ship begin to list. People often panic if a ship lists by 10 to 12 degrees, which can lead to several people jumping overboard.

2.2.3 Capability to be developed

Preventative measures

Lessons have been learnt both in Sweden and globally from previous incidents, such as the fire disaster on the *Scandinavian Star* passenger ferry in 1990, and the community's capability to prevent a similar incident has thus been strengthened. One example is that fire protection on board ships has been developed to prevent similar situations from occurring. Local-application fire-fighting systems are

becoming increasingly common whereby specific flammable surfaces are given special protection as a complement to the rest of the ship's fire protection. Bearing in mind the serious impact an uncontrolled fire can have, it is important to continue to develop this and other types of preventative measure.

Response (preparatory) measures
Past experience has led to numerous preparatory measures. In the *Scandinavian Star* disaster the rescue services were initially called out to the wrong location. Therefore a complementary new satellite system for giving a ship's position has now been introduced, which has reduced the probability of receiving an incorrect position from the ship.

On the whole, current expertise for responding to a ship fire is sufficient, with planning and procedures for effective management, co-operation, communication, and utilisation of resources. It is important that this capability is maintained.

2.3 Emissions of hazardous substances (CBRNE)

Hazardous substances are necessary for the society's functionality and are used by many stakeholders– e.g. in industry, research, energy production, and health and medical care, as well as in most households. An incident could impact on an individual or affect many people, society, and the environment. The management of hazardous substances is strictly regulated in order to minimise the risk of accidents and restrict access by unauthorised persons. The severity of the impacts of an emission depends on many factors, such as the substance's properties, the size of the emission, the location of the accident, weather conditions, the length of the incident, and how it is managed.

There is a risk of emissions of hazardous substances during their production, use, and transport. They can be spread through an accident that results in fire, explosion, or toxic emissions. Hazardous chemicals can also be spread on a large scale through a very high number of small emissions, such as from households. Substances spread in this way include medications in wastewater, biocides, mercury in energy-saving light bulbs, and cadmium in agriculture.

There are many examples of incidents involving chemicals. One is the incident in Teckomatorp in 1975, where the company BT Kemi had buried barrels of pesticides which leaked into the soil and water. The impact of the toxic emission has lasted since 1966, when gardeners had problems with their plants, through the early 1970s, when locals experienced breathing difficulties due to extensive poisoning of the land. Decontamination of the land is still ongoing and the cost to date is estimated at half a billion Swedish kronor.

Another example is the construction of the railway tunnel through Hallandsåsen ridge. 1,405 tonnes of sealant containing the toxic substance acrylamide were used in the project. In October 1997, it was discovered that cows had been poisoned because the substance had leaked into watercourses in the local area. Construction of the tunnel had to be halted and the incident caused extra delays and increased the project's costs.

Oil spills are yet another example of emissions of chemical substances. An oil spill can cause serious damage. Plant and animal life can be damaged, beaches can be contaminated, and sea beds can be damaged or destroyed. Oil spills also have a social and economic impact on those affected.

Over the past 15 years, oil shipments from Russia to the North Sea via the Baltic Sea have increased tenfold. The ships are specially adapted and are increasing in size, with tank volumes ranging from 100,000 to 250,000 tonnes of oil. The Baltic Sea is also becoming an increasingly busy place for all types of ships – e.g. professional fishermen and wind farms. During the period 1998–2008, some 200 to 400 oil spills a year were discovered in Swedish waters.

The most recent major oil spill in Swedish waters took place on 11 September 2011 when two ships collided in the North Sea, with a subsequent oil spill from a bunker tank. This led to a major oil spill in Bohuslän, primarily in the Tjörn area. The amount of oil has not been confirmed, but it is at least 300 tonnes of bunker oil. The spill led to a resource-intensive clean-up operation in the archipelago.

Sweden is a relatively large producer of nuclear and radioactive substances. Sweden's use of nuclear energy also produces high-level radioactive waste, which must be dealt with and monitored for a long time until the waste can ultimately be deposited in the bedrock. Nuclear and radiological substances are used in energy production in the nuclear power industry. Radioactive substances are also used in a number of other activities in society, such as in health and medical care, industry, research, and teaching. Radioactive substances are classified as dangerous goods for transport purposes and subject to safety measures in laws and regulations.

MSB supports Sweden's stakeholders from the local to the central levels with co-ordination by supporting and facilitating oil spill protection and nuclear energy work in the field of CBRNE. There are jointly developed strategic focus areas for maintaining and increasing capabilities for managing accidents and crises involving CBRNE substances.

There are 10 nuclear reactors in commercial operation in Sweden. These are divided between the three nuclear power plants in Forsmark, Oskarshamn, and Ringhals. The plants in Forsmark and Oskarshamn have three reactors each while the Ringhals plant has four reactors. Furthermore, there are a number of additional nuclear facilities in Sweden. These include the nuclear fuel factory operated by Westinghouse Electric Sweden in Västerås and Clab in Oskarshamn, which is a central interim storage facility for spent nuclear fuel. There are also a large number of nuclear reactors in some of Sweden's neighbouring countries.

There have been three serious nuclear accidents in the world in the last 35 or so years. These were Three Mile Island (Harrisburg) in the United States in 1979, Chernobyl in Ukraine in 1986, and most recently Fukushima in Japan in 2011. In each instance the reactor cores were destroyed, but the impact on the surroundings varied greatly. The accident at Three Mile Island had little impact on society, while the radioactive emissions from Chernobyl spread over very large areas, including Sweden.

2.3.1 Responsibilities

This section covers responsibilities in the event of a nuclear accident.

The person responsible for operations at the nuclear power plant and its owner have primary responsibility for safety at the plant. In the event of an accident, they are also responsible for all preparedness actions in their own area and for reducing the impact of an accident, such as by keeping other stakeholders continuously informed about the course of events and possible developments. They must also compensate anyone injured as a result of the accident.

The Swedish Radiation Safety Authority is responsible for the supervision of nuclear facilities. This supervisory responsibility includes ensuring that the companies that operate the facilities comply with the prevailing laws and regulations

on nuclear safety and protection against radiation. It also includes inspecting the facilities, monitoring operations, and reviewing documents and applications, as well as conducting overall radiation safety assessments of all the plants in Sweden.

In addition, a large number of responsible stakeholders are involved in preparatory and management measures. These participants are part of an emergency organisation for nuclear accidents, which is a nationwide network.

The county administrative boards play an important role in the organisation and have responsibility for their geographical areas. It is the county administrative board that is responsible for national rescue services in the event of a nuclear accident and for appointing an incident commander. It is also the county administrative boards which, with the support of the central authorities, make decisions on warnings, information, and advice to the public, as well as on measures such as evacuation, radiation monitoring, decontamination, and more. The county administrative board is responsible for ensuring there is a contingency plan for rescue services at accidents involving emissions of radioactive substances from a nuclear facility, whether in Sweden or abroad.[26] MSB is responsible for operational supervision of the county administrative boards' tasks relating to the rescue services and decontamination and for taking charge of the rescue services.

The municipality is responsible for providing information to its residents as well as for taking part in the planning of rescue services in the event of an emission of radioactive substances. The municipality is also responsible for receiving and providing accommodation for people after an evacuation and for decontamination after a nuclear accident.

The emergency organisation also includes the county council, police, nuclear power plants, SOS Alarm, the Swedish Radiation Safety Authority, SMHI, several national media companies, and a number of other Swedish authorities such as the Swedish Board of Agriculture, the Swedish National Food Agency, MSB, the Swedish Police Authority, the National Board of Health and Welfare, the Swedish Work Environment Authority, the Swedish Coast Guard, the Swedish Maritime Administration, and Swedish Customs. The organisation also includes the Swedish Armed Forces, voluntary organisations, and local safety committees. Other nations and the EU and UN can also be said to belong to the emergency organisation.[27]

2.3.2 Scenario analysis: Nuclear accident

The scenario which forms the basis for this analysis was developed in conjunction with SAMÖ-KKÖ 2011[28]. MSB and the Kalmar county administrative board were responsible for planning and carrying out the exercise.

The analysis was conducted in 2013 and was based primarily on data from the SAMÖ-KKÖ 2011 exercise, as well as on various reports on the fallout and decontamination of radioactive substances compiled by the Swedish Board of Agriculture, the FOI research institute, and the former Swedish Rescue Services Agency rescue agency, for example. In addition, MSB has used the Swedish Radiation Safety Authority's and the Swedish Energy Agency's risk and vulnerability analyses from 2013 as a foundation, as well as the National Board of Health and Welfare's Kamedo report on the incidents in Fukushima in Japan in 2011.

26. MSB, *Den svenska beredskapen för radiologiska och nukleära olyckor 2015. Handlingsplan*. (*Swedish preparedness for radiological and nuclear accidents 2015. Action plan.*), 2013.
27. Swedish Rescue Services Agency, *Den svenska beredskapen för radiologiska och nukleära olyckor 2015* (*Swedish preparedness for radiological and nuclear accidents 2015*), 2008.
28. SAMÖ-KKÖ 2011 was an exercise for an incident involving radioactive emissions for which MSB and the Kalmar county administrative board were responsible. Two tried-and-tested concepts – the co-operation exercise (SAMÖ) and the nuclear power exercise (KKÖ) – were combined into a single exercise. The aim was to develop the capability to respond to both the short-term and long-term impact of a nuclear accident.

During the process of analysis, the Swedish Radiation Safety Authority, Svenska Kraftnät (the authority responsible for ensuring that Sweden's power supply is safe), the National Board of Health and Welfare's groups of medical experts on radiological and nuclear incidents, and MSB's own experts in the field have read drafts and provided comments on the content of the analysis.

Scenario

The nuclear accident occurs without warning on a severe winter's morning in February, with snow and biting cold.

Geographic location

The scenario plays out in the vicinity of Oskarshamn. Large parts of mainly southern Sweden will be affected by the accident.

Sequence of events

In the early hours of 2 February disruptions occur at the nuclear power plant owned by OKG AB[29], outside Oskarshamn. Early in the morning there are problems cooling two of the reactors, which causes staff at OKG to decide on a "heightened alert". Further problems arise later in the day and the various backup systems for cooling the reactors do not function as intended. OKG decides to sound a breakdown alarm. The failing cooling leads to meltdown and radioactive emissions as the filter system does not work as intended. Because of this the emissions are higher than expected. The emissions continue for two hours in the early hours of 3 February. OKG initially rates the accident as level 5 on the INES scale[30], which goes up to 7.

Capability analysis

An accident involving radioactive emissions is a complex incident with a relatively lengthy course of events. In the event of an accident, such as a meltdown, the radioactive substances in an overheated reactor core are very likely to be dealt with by so-called accident filters, with which Swedish reactors are equipped. In this scenario these filters are not working and emissions ultimately become a reality. Response measures, however, will begin before the actual emission happens. Responsible stakeholders, such as OKG and the county administrative board, will be able to launch the relevant disaster-preparedness structures and procedures in advance.

When the warning of a heightened alert in the nuclear power plant is given, the relevant organisations are contacted as set out in an emergency plan. Those on duty at these organisations will initiate the disaster management structures, including teams with relevant functions. Co-operation conferences will be organised at both the regional and national levels. Based on the premise that stakeholders share their information and assessment of the situation in their area of responsibility, MSB will draw up and continually update an overall national status report. The status report provides a cross-sectoral description of the impact, crisis management measures, and need for co-ordination. It is intended to strengthen the joint action by stakeholders at the national level and may serve as a basis for prioritisation.

The PR officers' network for radio-nuclear issues, which is co-ordinated by MSB, will be activated to co-ordinate information about the accident.

29. Oskarshamnsverkets Kraftgrupp AB (OKG) is in turn owned by E.ON.
30. INES stands for the International Nuclear and Radiological Event Scale.

Experience gained from exercises shows that the process of launching these types of structures and procedures works relatively well, but also that there remains a lot to do to help to ensure quicker, more effective action in order to limit the consequences of the incident. It is difficult to assess how much quicker and more effective the work can be. The challenges in an incident of this kind are immense.

Impact assessment

Human life and health

In the main, there are three different types of health problem that could arise as a result of the incident: acute radiation injuries, cell changes/cancer, and psychological problems. In addition, people could be injured or die in accidents that could occur as a result of the incident, i.e. as an indirect effect.

MSB assesses that no one suffers from acute radiation injuries in this scenario. A person would only suffer from acute radiation injury if they were exposed to very high radiation, which is very unusual. In Fukushima, for example, there were no cases of health effects or death due to direct radiation injuries among the staff who worked to reduce the impact of the accident (more than 20,000 people were screened).

In the longer term, the question has been raised of a possible increase in the number of people who develop cancer because of exposure to a low dose of radiation over a long period of time. Several research reports indicate that the incidence of cancer due to a similar incident will be very low, if it is even possible to demonstrate statistically – in each case it is impossible to distinguish from cases of cancer with other causes. The accident at the nuclear power plant and the radioactive emissions will, however, have profound psychological effects on the population. It will be both a major media incident and a personal crisis for individuals. The evacuation from contaminated areas will in itself create both practical and psychosocial problems. Over the longer term, psychosocial stress (e.g. in the form of worries about the future and depression) may cause deaths.

In this scenario the county administrative board decides to evacuate the inner emergency zone the same day the incident occurs, which affects 2,500 people. In addition, around 12,000 people are evacuated from the area around Värnamo, Emmaboda, Högsby, Nybro, and several municipalities after it becomes clear that these municipalities have been affected the worst by the fallout.

Residents are not allowed to move back permanently until the area has been decontaminated and control measurements have been carried out. In the analysis it is assumed that the area from which the 12,000 people were evacuated has still, over a year after the incident, not been cleaned up sufficiently to enable everyone who wants to return to do so. This is in light of the experiences of Japan, where it emerged that decontamination is very time-consuming work.

Society's functionality

The burden on health care depends partly on how successfully the public are informed of risks and to what extent they will be offered medical examinations. Health care could be burdened by a loss of staff as some health-care staff may have had to evacuate their homes. The medical facilities located in areas that are being evacuated must evacuate patients, which is risky. Increased waiting lists and delays because of the incident could last more than a year.

Transport restrictions are expected to be introduced for all modes of transport. Road and rail traffic are subject to the most extensive restrictions, but most of these can be lifted within a month of the accident. After one year there could still be possible restrictions on local minor roads where decontamination has not yet been carried out.

The power supply is affected because the nuclear power plant can no longer produce electricity.Although Sweden could compensate for the loss of power from the closed reactors in Oskarshamn with increased production in other facilities and increased imports, there could still be a power shortage in parts of southern Sweden. Oskarshamn's location in Sweden's national power grid makes it difficult to replace the power produced by the reactors.

If all the nuclear reactors of the same type are forced to close for a longer period, this would impact the whole of Sweden's energy supply.

In the first few days after the nuclear accident, there will be a marked increase in electronic communications. This can lead to an overloading of certain parts of the mobile networks, not only in the areas closest to the nuclear plant where the incident took place but also in other parts of the country.

The effects on food production in the present scenario are considered to be limited. However, the scenario involves great difficulties for individual farmers where land is deemed unusable for years to come.

The forest will also be affected by the fallout, which means that restrictions on meat from wild animals will be needed, as well as recommendations on avoiding berries and mushrooms from this area.

The EU's interim thresholds on goods from the area with potential radioactive contamination will come into force immediately after the incident. This means that anyone who puts food products on the market must be able to guarantee that they do not exceed these thresholds.

Exports from Sweden to the rest of Europe and the world will probably decrease, irrespective of whether these thresholds can be met, because people will be concerned about eating foods that come from an area affected by a fallout. In 2012, agricultural and food products accounted for approximately 5 per cent of Sweden's total exported goods.

Forest products from the contaminated area could be subject to export restrictions or reduced demand.

Economic values and the environment

In the short term, MSB estimates that the major costs consist of: the clean-up effort; the evacuation of thousands of people; a decline in production as a result of e.g. the evacuation of areas where businesses are run, delays in transport, reduced demand for goods (mainly food); and additional costs for health check-ups, taking food samples, and so on.

One important cost is the increased sampling and measurement of products in the food chain and environmental samples. Considerable measurement capacity is needed, and this requires both sophisticated measuring equipment and trained personnel. This is expected to continue for several years, and incurs extensive costs overall. For example, Sweden still measures the presence of radioactive substances in reindeer meat after the Chernobyl accident in 1986.

According to *Japan Daily Press*, a research institute has estimated that the costs for decontamination after the accident in Fukushima in 2011 amount to the equivalent of USD 50 billion, which is five times what the Japanese government has budgeted for. This indicates that the total economic costs following a nuclear accident in Sweden today would probably exceed SEK 50 billion.

There would be other impacts for Sweden's economy, such as a fall on the stock exchange, falling exchange rates for the Swedish krona, and high interest rates.

The fallout from the Oskarshamn nuclear power plant mainly affects large parts of Småland in southern Sweden. Approximately 290,000 hectares of arable land are affected by radioactive fallout. Livestock and feed are contaminated but to a limited extent because most of the feed and livestock are indoors in the winter.

The forestry industry's production of forest raw materials will probably decrease in the contaminated area because no one wants to use raw materials from this area.

Democracy, and human rights and freedoms

It may take time for the authorities to obtain a clear understanding of the incident and this could cause a delay in informing the public about what has happened. This in turn could result in speculation regarding both the causes of the accident and the extent of the radioactive emissions, as well as the associated risk. People will look for information from a variety of sources to relieve their anxiety and satisfy their desire to find out what is happening. How well authorities manage to disseminate accurate information will impact on health care, for example, and on how many people decide to evacuate the area spontaneously.

There is a risk of confidence decreasing in public institutions because of the nuclear accident, from the time the incident occurs and for several years thereafter. This could occur as a result of the following:

- People want more information than the institutions can provide. There is also some risk of conflicting information, because many stakeholders are involved in the management of the incident.
- Since radiation risk is a complex area to provide information about, and knowledge of radiation is generally low, this can lead to problems of trust. Lessons have been learned from the Fukushima accident, which has strengthened the capability to provide information about this type of incident.
- People may feel unfairly treated. In connection with the various measures taken to address radiation risks and protect people and property, there will inevitably be conflicts between different interests.
- The public institutions' actions do not meet expectations.
- How the media choose to report the incident and disaster management. Meanwhile, public institutions partly depend on the media to communicate important information to the community in a good way. This makes it difficult to assess the extent to which confidence will be affected.

Probability

To date, Sweden has not had any nuclear accident involving radiological emissions. There have been three serious nuclear accidents in the world in the last 35 or so years. In each instance the reactor cores were destroyed, but the causes and impact varied greatly. It is not possible to apply the statistics from these past accidents and make a quantitative probability assessment of a nuclear accident in Sweden with radiological emissions. For example, Swedish nuclear power plants are equipped with pressure-relieving accident filters. These filters are designed to take care of at least 99.9 per cent of the long-lived radioactive substances that can come out of an overheated reactor core. Such filters were not fitted in Chernobyl or Fukushima. In the scenario, however, it is assumed that these filters are not working as they should.

Uncertainty assessment

The extent of the impact depends largely on the size of the emissions to the surroundings and on the composition of various radioactive substances in the emissions (isotopes). How the plume (the "cloud" of radioactive substances) spreads and how the radioactive material is deposited also determine the severity of the scenario.

Sensitivity analysis

Examples of variables affecting the outcome of the incident include the size of the areas evacuated and how long they are evacuated for, prioritisation and decisions in the clean-up effort, the extent of disruptions to the power supply, and how well the public's concerns are managed. Timing is an important variable for the impact, particularly for agriculture, because there is a big difference in how production is affected in different seasons.

2.3.3 Capability to be developed

Preventative measures

Swedish nuclear reactors are very safe by international and historical standards. Even if a meltdown occurs, there are so-called accident filters that deal with a very large proportion of the radioactive substances that are dangerous to humans, animals, and nature. Nevertheless, a nuclear accident with subsequent emissions is an incident that would have a particularly serious impact. Preventative measures *must* be taken and constantly developed. Built-in safety elements such as accident filters and regular maintenance of the facilities as well as regular supervision of rules and procedures are strictly necessary measures, which are also being implemented.

Response (preparatory) measures

There is comprehensive planning material and an extensive knowledge base on how society should respond in terms of management, co-operation, and communication in the event of emissions from a Swedish or foreign nuclear power plant. This includes, for example, the county administrative boards' planning for rescue services and decontamination (in the counties affected) and procedures for calling out the necessary units. There are also special co-operation forums and networks in which stakeholders participate. Like all planning for disasters, including the function in temporary structures set up to manage operations, there is a difference between theory and practice. Experience from exercises shows that setting up these types of structures and procedures works relatively well, but that there remains much to do to respond more rapidly and effectively in the start phase. This reflects tasks that need to be carried out for all types of disasters, such as establishing clarity about who is responsible for what, agreeing on a common status report, and becoming even better at communicating with the public. One of the most difficult challenges is the creation of conditions for responding over a more prolonged course of events. The resilience of several stakeholders – particularly regarding the availability of human resources – is limited.

One of the best ways of testing and developing actual capabilities during rare events is through exercises. In the present situation, the nuclear accident scenario is considered to be relatively well practised through exercises, compared with other risk areas.[31] It cannot be emphasised enough how important it is to maintain this level of knowledge and competence.

31. For example, nuclear power exercises (KKÖ) are carried out every other year in one of the three counties with a nuclear power plant. These exercises include, from a sector perspective, all of the stakeholders involved in the preparedness for nuclear accidents at the local, regional, and central levels. In 2011 the SAMÖ-KKÖ 2011 exercise was also carried out, which was a combination of a co-operation exercise (SAMÖ) and a nuclear power exercise. A smaller follow-up exercise was also carried out in May 2014: SAMÖ Focus.

2.4 Dam failure

There are approximately 10,000 dams in Sweden. For just over 200 of these facilities a dam failure could have a major impact on life, health, the environment, and economic values. For around 20–25 of the dam facilities in the major rivers used to generate electric power, a dam failure would entail very heavy flooding along the river valley, and would not only endanger human life and health but also cause major disruptions to critical infrastructure.

The scenario describes a dam failure in one of Sweden's largest dams used in hydropower production, high up in Ljusnan, which runs through the counties of Jämtland and Gävleborg and flows into the Baltic Sea at Ljusne. The power plants along the river account for six per cent of the country's hydropower.

There have been dam failures with a relatively limited impact in Sweden, such as in Sysslebäck (1973), Noppikoski (1985), and Aitik (2000). In Sysslebäck, buildings and roads were destroyed and one person died. In Noppikoski, a power plant, roads, bridges, and forest land were damaged. Another dozen smaller dam failures have occurred in dams used in hydropower production in Sweden.

2.4.1 Responsibilities

There are several laws and regulations designed to ensure satisfactory dam safety and preparedness for dam failure. Two of the laws are fundamental to dam safety: the Swedish Environmental Code (1998:808) and the Swedish Civil Protection Act (2003:778). All dams are covered by the rules set out in the Swedish Environmental Code. The dams classified as hazardous operations are also covered by certain provisions of the Swedish Civil Protection Act.[32]

According to the Swedish Environmental Code, the owner or the operator of the dam has very far-reaching responsibilities. In the field of dam safety this means that the person in charge of maintenance, usually the owner of the dam, is required to maintain the dam to ensure there is no harm to the public or damage to private interests from changes in water conditions. The operator shall establish and follow procedures for carrying out their own controls. The county administrative board is the supervisory authority.

Svenska Kraftnät, the authority responsible for ensuring that Sweden's power supply is safe, has a central official role in dam safety. In accordance with its remit, Svenska Kraftnät shall promote dam safety in Sweden, partly by following and taking part in the development of dam safety, reporting regularly to the Swedish government on developments, and, if necessary, proposing measures as well as highlighting the need for research. Svenska Kraftnät has the central responsibility for supervisory guidance on issues relating to dam safety under Chapter 11 of the Swedish Environmental Code. In addition to supervisory guidance, the development of preparedness for dam failure and competence supply are other key areas of work for Svenska Kraftnät.

In the event of a dam failure, the rescue services are responsible for the rescue response. The municipality/municipalities and county administrative board(s) concerned have a geographical area of responsibility, which includes e.g. planning for evacuation and co-operation initiatives. MSB can assist in supporting co-operation (implementation of co-operation conferences), developing status reports, and co-ordinating information. Depending on the scope and the functions affected, a number of other stakeholders – authorities and private organisations – are responsible for managing the impact of the incident.

32. Svenska Kraftnät and the Swedish Rescue Services Agency, *Dammsäkerhet och beredskap för dammbrott – Information om tillsyn enligt miljöbalken och lagen om skydd mot olyckor*. (*Dam safety and preparedness for dam failure – Information on supervision in accordance with the Swedish Environmental Code and the Swedish Civil Protection Act*.)

2.4.2 Scenario analysis: Dam failure

This scenario was analysed in 2012 and carried out mainly on the basis of previously conducted analyses, including *Dammsäkerhet – Ett pilotprojekt i Ljusnan* (*Dam safety – a pilot project in Ljusnan*) (Elforsk report 05:38, 2006), *Störtflod i Dalälven* (*Deluge in Dalälven*) (Swedish Rescue Services Agency 1996) and impact descriptions of flooding in central Norrland 2000–2001.

The scenario and analysis have been agreed with representatives from MSB, Svenska Kraftnät, Fortum, Vattenregleringsföretagen, and the county administrative boards of Gävleborg and Jämtland.

Scenario

The dam failure occurs on 13 September after a snowy winter, a cool spring, and a very wet summer.

Geographic location

The scenario unfolds at a dam in Ljusnan.

Sequence of events

On 31 August the Swedish Meteorological and Hydrological Institute (SMHI) issues a class 3 warning for high flows for parts of Lillälven, Ljusnan, and Voxnan. There are also large areas of flooding along the Dalälven river. A storm in the Jämtland mountains causes waves in a reservoir located straight in the direction of the wind. Despite using floodgates to release the maximum amount of water possible, the reservoir continues to rise and now reaches the dam limit. Suddenly the water gushes out in an area high up the dam's downstream slope. At 21:00 the stake holder in charge of regulating water levels in the area – Vattenregleringsföretagen – notifies SOS Alarm of the dam failure, explaining that the water is quickly heading for the nearest village. SOS Alarm follows the established plan for a class A alarm, "Dam failure at dam X", and notifies the dam owner, rescue services, police, county council, Swedish Transport Administration, Svenska Kraftnät, county administrative boards, and the broadcaster Sveriges Radio. Important messages for the public are broadcast on both radio and television. An immediate evacuation of neighbouring communities downstream begins. In just one hour a flood wave threatens to flood homes and properties. It also threatens roads, bridges, railways, power lines, and other infrastructure. Gradually the flood wave evens out and is replaced by rapidly rising water levels further downstream in the river. When the water masses reach the hydroelectric reservoir and dams located downstream, they are also destroyed, which adds to the flow and the devastation along the river valley.

Capability analysis

The course of events in the scenario includes a number of proactive measures – some of them stated in the scenario, others not – which responsible stakeholders have probably carried out before the dam failure in question. SMHI and Vattenregleringsföretagen, for example, prepare forecasts for rainfall and run-off in the rivers, which municipalities, central authorities, and the relevant county administrative boards study. Established networks, such as in the co-ordination group for information during high waters, co-operate via daily phone meetings. The course of events would be closely followed by the media and communicated to the public.

The joint authority portal Krisinformation.se would continually publish updates based on the information released by the responsible stakeholders via their own channels. After SMHI's class 3 warning, MSB would have initiated co-operation conferences and established an overall national status report.

These and other measures are examples of structures and procedures for co-operation, management, and communication which are in place and are relatively well established in the event of a dam failure and its subsequent impact. Furthermore, the procedures for alerting the relevant organisations and notifying the public during the incident should run smoothly. Rescue services and other stakeholders can start the evacuation immediately. The preparations can be assumed to contribute to an efficient evacuation of a large majority of the population in the affected area. The time available for evacuation is, however, limited. There may be vulnerable groups in the area, such as elderly people living alone who have less opportunity to absorb the necessary information about assembly points, for example. Based on the material for this analysis, it is not possible to say whether people would be unable to be evacuated, and if so, how many.

Operations in the area will be hit hard. It is only a week later, when the water has receded, that it is possible to begin clearing rubble and repairing the infrastructure for power supply and roads. It could take anything from a few days to a few weeks to re-establish the national electricity grid and regional network on a provisional basis. The local network would probably take months to re-establish. Electronic infrastructure also takes time to re-establish, perhaps weeks, as it is also dependent on electricity. Temporary bridges for road traffic can be in place within a relatively short time with the help of e.g. the Swedish Armed Forces' reserve bridge materials. Reconstruction, however, takes a long time.

Impact assessment

Human life and health

There is a risk of a lot of deaths when the flood wave recedes. Around 9,000 people live in the flood risk area and they will need to be evacuated. The flood wave reaches the first community only an hour after the dam failure. The evacuated people will not be able to move back for a long time and temporary accommodation must be arranged. Some of the evacuated people are likely to suffer from mental ill health because of their situation.

Society's functionality

Dam failure would have a far-reaching impact. Large areas are flooded and a lot of buildings and infrastructure are destroyed by the water. The flood wave drags along roads and railways, as well as several intersecting bridges, power cables, and communication infrastructure. All electricity production downstream is taken out. The power grid is affected at all system levels, but local and regional networks are affected the most. There could be power shortages in southern Sweden due to limitations in the national grid's transmission capacity.Transport to and from northern Sweden is significantly reduced with a possible impact on e.g. industry, health care, and supermarkets. It will not be possible to call the 112 emergency number from the local area as power and telecommunications have been taken out.

The county councils in Jämtland and Gävleborg will probably experience major difficulties due to failing electronic communications. Other county councils in Norrland may also be affected for the same reason. Hospitals in Norrland, for example, will lose their electronic communication connections with southern Sweden, which creates serious problems for essential health care.

Several farms with livestock would be flooded. The same applies to water treatment plants, dams, service stations, and industrial areas, as well as to oil storage tanks with the accompanying risk of oil and petrol leakages.

The quality of drinking water may be affected by the dam failure.

Economic values and the environment

The dam failure has a major economic impact in terms of both lost capital and rebuilding costs, as well as indirectly through lost income because businesses are forced to stand idle. The repair and restoration costs alone are estimated at several tens of billions of Swedish kronor. Rebuilding dams is very expensive and time-consuming.

The environment would be affected – e.g. the appearance of the valley would change and the river's direction could possibly change where the flood wave moves soil mass. The river, which has been regulated since the 1950s, will be unregulated in the future. Oil and petrol from flooded service stations and industrial operations could leak. Cultural heritage sites (monuments, Iron Age tombs, Stone Age settlements, church ruins, etc.) would be flooded or washed away.

Democracy, law and order, and human rights and freedoms

Large-scale evacuation of communities can lead to an increased probability of looting in the area. People who do not want to leave their homes will be forced out by the water.

The scenario could also lead to changes in legislation on dam safety.

Probability

Common causes of dam failure are the inability to release sufficient water during high water flows, and leaks in the actual body of the dam or in the foundation. According to international statistics, the probability of dam failure in high dams[33] is in the order of 0.0001 on an annual basis (once every 10,000 years), and fewer than 0.5 per cent of the dams built after 1951 have failed.

Uncertainty assessment

For several years, dam owners along the country's eleven largest rivers have developed detailed flow and flood mapping for the worst dam failures in collaboration with Svenska Kraftnät. The assessment of the impact of dam failure is based on ongoing work to increase preparedness in the valleys, including studies with mapping and flood wave simulations. As regards the area that would be flooded, and the operations that could be affected, uncertainty in the assessment is *low*.

Uncertainty in the impact assessment is higher. The assessment of the economic impact of dam failure is based solely on rough estimates.

2.4.3 Capability to be developed

Preventative measures

Bearing in mind the catastrophic impact that can result from a dam failure, it is of the utmost importance that dams are built to be as safe as possible. The same applies, of course, to maintenance and procedures for the dam's operation. The general assessment is also that knowledge of dams and their risks is continuously being developed and that existing dams are being strengthened.

33. I.e. "*large dams*" according to ICOLD's definition (15 m high).

Response (preparatory) measures

In the event of a dam failure, some of the impact in terms of e.g. buildings, infrastructure, and cultural values will be disastrous. A rapid response to the incident can, at best, prevent human injury and death. This capability requires that the planning, the procedures for raising the alarm, and – where appropriate – the evacuation plans for the areas affected are updated and exercised regularly. It is important that structures for management, co-operation, and communication are very well prepared ahead of a possible dam failure.

Disruption to technical infrastructure and supply systems

3. Disruption to technical infrastructure and supply systems

This category includes technical infrastructure and supply systems that are of vital importance to ensuring the functionality and continuity of vital societal functions and society as a whole. This category also includes disruption caused by humans but without any antagonistic intent, as well as disruption caused by technical faults, a lack of maintenance, or faulty design.

3.1 Disruptions to the energy supply

Disruptions to the energy supply include incidents resulting in disruptions to the power supply, district heating supply, fuel supply, gas supply, and district cooling.

Sweden imports about 60 per cent of its energy – primarily coal, oil, uranium, and natural gas. Our largest domestic energy sources are biofuels and hydropower.

Power supply

The power supply has a special position within the energy system since electricity is almost always required for the supply of all other types of energy. In addition, the supply of electricity is critical for the functioning of other activities, including transport, food supply, health and medical care, IT systems, electronic communications, and municipal technical services. This means that disruption to the power supply also hits the health and medical care and social care sectors particularly hard since these social sectors depend heavily on electricity, water, food, transport, IT systems, and electronic communications. Although some segments have redundancy in the form of e.g. backup power, this is lacking in other areas, which poses a good deal of strain overall.

One obvious problem is that the electricity is consumed as soon as it is produced, meaning that severe disruption to the power system has an immediate impact.

In the event of prolonged power outages, the uncertain access to backup power equipment is a serious shortcoming, as is the uncertainty regarding how diesel will be supplied to this equipment. Although some supplier agreements have been put in place, there is uncertainty regarding diesel supplies in the event of a serious incident. In relation to backup power, the greatest uncertainties pertain to its sustainability and to procedures for how the counties' stakeholders test their backup power, its maintenance, and its start-up.

Fuel supply

Sweden imports crude oil by way of the global oil extraction market, primarily from the North Sea and Russia. The crude oil comes to one of Sweden's four crude oil ports in Gothenburg and Lysekil and is stored in rock shelters, primarily at the refinery in Lysekil. These locations are also home to the three refineries in Sweden that produce fuel and heating oils.

Generally, the finished oil products are initially stored in oil depots. These are located in around 25 locations in Sweden. The products are then transported to filling stations and end clients, such as property owners, primarily by tanker truck. On average, each filling station is filled around twice per week. There is, however, a large variation. Some locations are filled several times per day, while others are filled maybe only every other week. Rising diesel use in cars has resulted in more filling stations needing to be filled more often.

In accordance with requirements imposed by the International Energy Agency (IEA), Sweden has peacetime oil stocks sufficient for 90 days of normal consumption. The intention is for this to be used in the event of a total stoppage of deliveries to Sweden. The oil stock is split between the country's various depots. Hauliers in Sweden generally have no or very small fuel reserves.

Fuel supply vulnerabilities became apparent during the blockades that took place in France and the UK in 2000. Unhappy with the increase in fuel prices, fishermen, truck drivers, and farmers blocked a total of 80, or one-third, of France's refineries and depots. This resulted in several parts of the country running short of fuel that very day. The blockades began to subside after six days. The impact was not extensive, and the incident was regarded largely as a low-intensity conflict.

Following the situation in France, similar protests took place in the UK. Here protests lasted for five days and the incident was regarded as a national crisis. The protests were felt by most of the country. Unlike France, most stakeholders in the UK lacked any meaningful fuel reserves.

3.2 Disruption to electronic communications

Electronic communications are covered by the overall electronic communication networks and services with associated facilities and services, as well as by other radio use such as telecommunications, the internet, and radio. Electronic communications are used in everything from phone calls, the exchange of information, and information searches to financial transactions, as well as for controlling and monitoring industrial processes. Together with electricity, electronic communications are vital to maintaining the normal functioning of society. Businesses run on electricity and they are controlled and monitored with the help of electronic communications.

Electronic communication is largely international, and network traffic is constantly crossing national borders. Telephony and data transmission systems are linked with one another, as well as being completely independent to some extent. Operations and monitoring centres are located in the countries where it is most effective to be located, and these depend on their extensive systems working.

The direct impact from disruption depends on which networks and/or services are affected. Overall, it becomes difficult for people to communicate with each other and with the different systems, as well as to monitor the different systems. For some systems it is only the monitoring function that ceases to work, while other cease to work completely. Dependence on these systems is complex and not always obvious. One impact could be that information used by the authorities and other stakeholders for their status reports is unavailable or cannot be transmitted. The status reports then run the risk of being misleading, and decisions on measures to be taken risk being made on the wrong grounds.

Common impacts include disruption to society's alarm functions, such as fire alarms, security alarms, and emergency numbers. Other impacts include interruptions to operations and monitoring systems for electricity, district heating, and the supply of drinking water, as well as disruption to the food chain, payment systems, and the transport sector. It may also be more difficult to disseminate information to the public via radio, television, and internet.

Several municipal stakeholders lack both backup power and alternative means of communication. Several municipalities use IP telephony in their municipal activities. According to some county administrative boards, this has been demonstrated to result in problems in the event of power outages which, on some occasions, have knocked out the municipalities' IP exchanges.

Several county councils have not implemented Rakel as their primary secure and protected means of communication for alarms and co-operation as part of the OCO function pursuant to the National Board of Health and Welfare's recommendations. Communication and collaboration opportunities during a serious incident may therefore be limited. According to the county administrative boards, the counties' stakeholders have analysed the robustness of their electronic communications only to a limited extent – e.g. most of the counties' stakeholders lack dual connections for the telephony systems. There is insufficient knowledge and understanding of how electronic communications work, and of how responsibility for their robustness is shared between operators, buyers, and the authority.

GNSS

GNSS stands for "Global Navigation Satellite System" and is a generic term for satellite-based navigation systems such as GPS (American), GLONASS (Russian), Galileo (European), and Beidou/Compass (Chinese).

GNSS is widely used in many sectors of society, and the services used are mainly based either on positioning data (such as map functions, navigation support, and device monitoring) or on time data (such as synchronisation of time and frequency between different IT systems and UTC time[34]).

Today's society is more and more accustomed to being able to use GNSS systems, and dependence on them is constantly increasing. In principle, all enterprises providing or using services for positioning, navigation, and the synchronisation of time and frequency depend on GNSS systems working. Several of the services have internal clocks that continue to work even without GNSS; however, they are not as precise as GNSS-based clocks.

3.2.1 Responsibilities

Disruption to electronic communications can occur for several reasons. This is why several stakeholders are part of preventative efforts. Among these stakeholders are owners and operators of the infrastructure – i.e. networks and services – that form the basis of communication. The Swedish Post and Telecom Authority (PTS) has overall responsibility for ensuring that everyone in Sweden has access to secure communication services. This is achieved by way of a supervisory role, as well as by encouraging increased network robustness.

Regarding GNSS, the owners of the satellites and other infrastructure required to maintain each system have a special responsibility. Existing systems are either under state control and operation (e.g. the GPS system managed and developed by the US and its military) or under supranational/international civilian control (e.g. the European Galileo system being constructed and ultimately to be controlled by the EU and the European Space Agency).

If electronic communications are disrupted – as in the GNSS-related scenario below – this will have an impact on a number of stakeholders' activities. Owners and operators will have a special responsibility for restoring and, where appropriate, repairing damaged infrastructure – e.g. other businesses will need to ensure they have access to other means of communication. MSB can assist in supporting co-operation (implementation of co-operation conferences), developing status reports, and co-ordinating information.

34. UTC time, Co-ordinated Universal Time. UTC is the reference for exact timings worldwide.

3.2.2 Scenario analysis: Disruption in GNSS

The scenario *Disruption in GNSS* was analysed by MSB in the 2012 national risk assessment. The analysis was largely based on an expert workshop held on 11 and 12 September 2012 with representatives from the Swedish Coast Guard, the Swedish Maritime Administration, SP Technical Research Institute of Sweden (SP), the Swedish National Space Board, the Swedish National Land Survey, the Swedish Post and Telecom Authority (PTS), the National Police Board (RPS), the Swedish Transport Agency, SOS Alarm, the Swedish Association of Road Transport Companies, the Municipality of Malung-Sälen, the Swedish Armed Forces, MSB, and FOI.

Uncertainties in the assessment were so extensive that MSB chose to undertake a deeper analysis by using the same scenario for the specific capability assessment that a number of authorities reported to MSB in conjunction with the submission of their risk and vulnerability analysis. This in-depth analysis was carried out in 2013.

Scenario

The scenario starts on 12 November and lasts for two weeks.

Geographic location

The scenario plays out throughout Sweden.

Sequence of events

It is 16:30 on a normal working day on 12 November. Many people are on their way home from work or school. Heavy fog lingers over much of the country. Without warning, Sweden no longer has access to services provided by GNSS.

Most of the direct impact of disruption in the use of GNSS is discovered immediately; however, additional problems may arise afterwards, particularly in systems or applications that depend on GNSS for time and/or frequency.

GNSS is assumed to be unavailable in Sweden for two weeks in this scenario. Other critical infrastructure is, however, assumed to operate as normal since there are no power outages during the course of events, for instance.

Capability analysis

Managing a two-week GNSS outage requires either redundancy or backup procedures for both positioning and time synchronisation. It is therefore very important that there is a quick and easy transition to backup procedures in order to minimise initial disruption.

Society is not accustomed to dealing with Disruptions in GNSS, which makes co-operation between the different stakeholders difficult to establish at first. Procedures for co-operation exist, but perhaps not in the configurations required at this time. In some cases – e.g. alarms – alarm services may need to be provided without a positioning service, which means that staff at both the alarm centre and in the patrol vehicles need to have good local knowledge. MSB will support co-ordination and establish a collective national status report. The status report provides a cross-sectoral description of the impact, the disaster-management measures, and the need for co-ordination. It is intended to strengthen the joint action by stakeholders at the national level and may serve as a basis for prioritisation.

Electronic communications are deemed to have adequate redundancy service for outages not to occur. Redundancy consists of alternative sources for time and time synchronisation. It is crucial that these alternative sources start working immediately and continue to function during the two weeks of disruption.

In many cases, backup procedures in the event of a loss of positioning services require more staff than normal. This requires the sustainability of key skills for the operation of various backup systems that stakeholders are not used to using.

Impact assessment

Human life and health

If the incident coincides with other major accidents, this may mean that the rescue services, ambulance services, and coastguard are unable to arrive as quickly as normal, resulting in several deaths.

Initially, the number of accidents can be expected to increase, as the collision avoidance system and other systems on board ships will not work, and individuals in cars or boats may go the wrong way or get lost. Navigation problems quickly become obvious, however, and most people will adopt safety margins and be more cautious in situations where they would have previously relied on GNSS.

Consequently, the assessment is that the scenario will only lead to a small number of deaths or injuries.

Society's functionality

There is now widespread dependence on GNSS in our society. The impact of disruption to positioning services often means that although activities can continue, they do so less efficiently due to staff not being accustomed to the alternative systems or due to an increase in manual work. This takes longer, resulting in delays and increased costs. For example, commercial aviation uses conventional systems for navigation, which means that while there are corresponding navigation aids on the ground, air traffic can continue without disruption. There are good conditions for directing air traffic using radar in Sweden. Ambulance services may be delayed initially, but activities will stabilise at a satisfactory level once backup procedures are fully operational.

Svenska kraftnät has assessed that the impact on electricity grid companies primarily concerns communication difficulties in industrial information and control systems (known as SCADA systems) and relay protection. According to Svenska kraftnät the impact is serious, although most stakeholders are expected to be able to manage this.

Time synchronisation disruption is more serious, but there is usually redundancy in the form of alternative systems. The assessment of the Swedish Energy Agency is that a GNSS outage will not have any major impact on society in terms of the supply of natural gas, oil, or fuel. The SCADA systems that control processes depend on GNSS for time synchronisation, but will continue by using internal clocks in the event of an outage. There may be long-term problems, however, if the alternative systems are not as precise as the GNSS-based systems. There is then a risk of island operation, which means that the alternative clocks' time indication gradually becomes increasingly inaccurate. If disruption lasts for several weeks, the internal clocks will start to drift and will need to be adjusted manually. None of the authorities that have assessed the scenario have indicated that island operation would involve a serious risk to their being able to maintain their activities.

Economic values and the environment

Delays in road and sea transport result in a decreased flow and consequently in some economic losses. However, these are not expected to be large.

Nevertheless, it cannot be ruled our that the scenario will not have an extensive economic impact if there is a major impact on communications or the power supply. Key sectors such as the banking industry may be affected by disruption.

Democracy, and human rights and freedoms

The scenario will be addressed in the media and there is a possibility that rumours will begin to spread about the cause of the incident and its impact on society. This may in turn lead to people feeling insecure. They may be worried that problems with bank transactions will make it difficult to shop using a card, which may encourage them to withdraw large amounts of cash.

Depending on how the incident is managed by the relevant authorities, the scenario may also lead to people looking for scapegoats, questioning why preparation had not been better, or wondering whether there will be serious consequences.

Probability

The GNSS-based GPS system is robust at a system level. The loss of GNSS signals throughout an entire country, as is the case in this scenario, has never occurred. If the number of operational satellites decreases, the precision of the positioning deteriorates in areas with inadequate coverage, while frequency synchronisation does not require as many satellites to be operational.

Extensive GNSS disruption has occurred in the past, e.g. during the second Iraq war[35], during a military radar system test in San Diego (2007), at a New York airport, and in North Korea. In Sweden, a storage location for stolen goods was found after the public in the area complained that mobile phones and GPS had stopped working. The location was fitted with jammers so that the stolen goods – e.g. in the form of boat engines – could not be found. Note that this is an example about antagonistic incidents and incidents in which people's conscious actions have unintended consequences. In this scenario, the starting point is that the GNSS outage has occurred unintentionally.

One possible reason why GNSS would be unavailable throughout the country simultaneously is the orbit of the satellites having been altered by a powerful solar storm, disrupting or destroying the satellites' electronics and radio communications.

Uncertainty assessment

The greatest uncertainty is how major disruption to transport would be, especially to road traffic and various modes of heavy transport. Many sectors of society depend on such transport. This means that the overall impact and the cost to society of the incident largely depends on how well the transport sector is able to withstand and respond to the scenario.

There are also uncertainties regarding the redundancy and backup procedures of various infrastructure owners for withstanding and managing the scenario. This applies primarily to the supply of power and drinking water.

35. The second Iraq war is usually defined as a war launched against Iraq by the US in the spring of 2003.

Sensitivity analysis

The impact assessment would have been different if the outage had lasted longer, as well as if the availability of GNSS had varied from hour to hour, or if the signals had been incorrect – i.e. if there was uncertainty regarding whether the systems were working or not. The impact would have an entirely different dimension if the disruption was intentional and the scenario was therefore antagonistic in nature. This would cause more concern among the public and increase the pressure for information. It would also mean that the judicial system would be involved in a completely different way, which would mean more stakeholders needing to co-operate. If the disruption was more geographically limited, the impact would be smaller.

Agriculture depends on GNSS in that large agricultural machines run on the basis of programmed routes. Had MSB's scenario played out during a season in which agricultural activities were more intensive, the impact on the agricultural sector would have been greater.

If the scenario had taken place during the summer, the impact on sea rescue would have been greater due to the increased number of pleasure boats in distress that would be unable to communicate their exact position. The number of boats in distress may have been even higher due to people's inability to navigate using methods other than GNSS.

3.2.3 Capability to be developed

A good knowledge of how different systems depend on GNSS is required in order to withstand and respond to such a scenario. In addition, there needs to be a good knowledge of the redundancy and backup procedures that exist, both internally and within those activities that one depends on. Finally, knowledge of how to activate and maintain redundancy is required, as well as knowledge of how to implement backup procedures. This applies to most sectors of society, but applies primarily within power supply, electronic communications, transport, and alarm systems.

As described in the analysis, society is not accustomed to dealing with disruption in GNSS. Several of the stakeholders affected by this scenario are not used to working together, which places a greater demand on capabilities across all dimensions. It is therefore desirable to conduct a joint exercise involving stakeholders from all levels of society. Such exercises should also be systematically evaluated and the management of experiences following exercises should contribute to the development of the participating stakeholders' emergency preparedness capabilities.

Since the scenario analysis was conducted, MSB has continued to work on issues related to GNSS and published the report *Importance of when and where – society's dependence on correct timing and positioning*[36]. The report primarily describes the risk of dependence on time and frequency synchronisation, in order to raise awareness of risks and vulnerabilities. The report includes several proposals for both general and technical measures designed to support efforts relating to the more secure use and reduced critical dependence on GNSS-based positioning, navigation, and time and frequency synchronisation.

36. Swedish Civil Contingencies Agency, *Vikten av var och när – Samhällets beroende av korrekt tids- och positionsangivelse* (*The importance of when and where – society's dependence on knowing the correct time and position*), MSB778 – November 2014.

3.3 Disruption to the payment system

The financial sector provides services including payments, access to cash, private insurance, and share trading. These services are provided by companies in the private sector. The payment system can easily be described as comprising technical and administrative systems that make it possible to pay for goods and services in society.

The Swedish Social Security Agency administers grants and social security benefits in the form of support to families with children, the sick, and people with disabilities, while the Swedish Pensions Agency administers things such as retirement pension payments. Payments are made through the banks' payment systems.

The financial sector depends on technical resources such as electricity, telecommunications, and IT. The sector is also largely concentrated in the Stockholm region and is highly dependent on certain key financial functions. The systems in the financial sector may face various types of interruption due to operator error, computer error, power outages, communications outages, or malware and other deliberate attacks.

The Swedish National Audit Office's review of the payment system's disaster preparedness against technical threats and risks in 2007 concluded that the existing shortcomings in the systems could result in unnecessary damage to society, businesses, and individuals. If the payment system is disrupted, confidence in the payment system could be damaged, which could in turn have a damaging long-term effect on society.

In 2000, the Swedish Riksbank's RIX system[37] was affected by a number of incorrect multiple payments due to an error in the communication system between the banks and RIX. That same year, Nordbanken had a problem with the software of an internal data system, which meant that the bank was unable to compile data for customer payments. In 2008, an error occurred in the Riksbank's network that made it impossible to have external contact via normal IT solutions.

No scenario analysis with a focus on disruption to the payment system has thus far been conducted within the framework of the national risk and capability assessment.

3.4 Disruptions in food supply

The flow of food from raw material to finished foods often consists of several steps involving several stakeholders and in which foreign trade is both extensive and important. The production and distribution of food requires a constant supply of input goods and other production factors. In addition, staff are required, and a number of technical systems need to work.

Approximately 60 per cent of the food we consume in Sweden is domestically produced, with the rest being imported. We are largely self-sufficient in terms of certain foods, such as grain products and butter. Other foods have to be imported in order to meet demand. The most important import markets for food and agricultural products in terms of economic value are Norway, Denmark, and Germany. For products such as fresh and chilled vegetables, the Netherlands and Spain are the dominant trading partners. Some of the imported products are processed in Sweden and then exported to other countries.

37. The Riksbank's system for transferring account-managed money.

Examples of disruption and outages in food production systems are technical faults, accidents, and a lack of consumables and fuel, as well as disruption to and outages of electricity, telecommunications, and IT systems. There are many reasons for disruption in the drinking water supply system, such as broken pipes, flooding, and contamination of water intakes. The impaired quality of drinking water is more common than a complete supply outage.

3.4.1 Responsibilities

No authority currently has complete responsibility for Sweden's food supply, either in terms of preventative or in terms of management measures.

Disruption can occur for various reasons, often because of transport flow disruption to or within Sweden. There are many stakeholders who are responsible for production and distribution. Most are private and are active in several different sectors. Sweden's agricultural production is part of the EU's common agricultural policy.

Since 2010 the Swedish National Food Agency has been responsible for the national co-ordination of food supply contingency planning in line with primary production during short-term crises. Other government authorities are responsible for their own preparedness in an event such as disruption to the food supply. MSB can, for example, provide support for co-operation, the development of status reports, and the co-ordination of information. MSB has developed proposed performance targets for disaster preparedness which, among other things, concern basic food supply needs.

3.4.2 Scenario analysis: Disruptions in food supply

This analysis was conducted in 2012 and is based largely on an expert workshop with representatives from the Swedish Energy Agency, the Swedish Board of Agriculture, the Swedish National Food Agency, the Swedish Transport Administration, the technical consultancy company Combitech, the Swedish Institute of Agricultural and Environmental Engineering (JTI), the Swedish Association of Road Transport Companies, crisis communicators from MSB, and FOI. The scenario had previously been agreed with representatives from the Swedish Association of Road Transport Companies and FOI.[38]

There are several possible reasons for disruptions in the food supply. The following scenario puts the initial focus on the cause of the disruption, which in this case is transport disruptions due to fuel shortages. The focus then switches to the subsequent impact on the supply of food.

Scenario

The scenario plays out in Sweden from 28 August to 10 September.

Geographic location

The scenario initially plays out in Lysekil before spreading to Gothenburg. The impact of the disruption affects the whole of Sweden.

38. A similar scenario was developed and analysed in 2002 and 2005 by the then Swedish Emergency Management Agency in co-operation with the Swedish Energy Agency (Swedish Emergency Management Agency, *External Examples*, 2005). This scenario has formed part of the basis for the development of the scenario for the national risk assessment, which has also been inspired by the actual fuel blockades in France and the UK in 2000.

Sequence of events

On Sunday 26 August, a threat is made by a country in the Middle East regarding the closure of a narrow yet important passage for global oil exports.

Crude oil prices are governed by a market which reacts strongly to developments. The effects are immediate, and by the end of the week the price of oil triples.

Strikes and blockades break out across Europe. Petrol companies increase the price of fuel in Sweden. By the end of the week, a litre of petrol costs SEK 45. The price of diesel increases to SEK 42 per litre.

Early on Saturday 1 September, hauliers commence blockades at the Lysekil oil refinery. By Sunday the protests spread to Gothenburg, meaning that all of Sweden's oil refineries are blockaded and prevented from delivering fuel to depots around the country.

The incident quickly impacts society. Motorists and hauliers not participating in the protests hoard fuel. This means that by the evening of 3 September, 80 per cent of Sweden's service stations are completely or partially without fuel. The shortages are felt by most sectors of society, especially with regard to the supply of food to shops and consumers.

Capability analysis

A disruption in fuel supplies has repercussions in several sectors of society. In this scenario analysis, the focus has been limited to how the food sector is affected by the fuel shortage. Initially, a comprehensive survey was condicted of the food chain and its dependence on fuel within and between each – see Figure 4.

Figure 4: Overview of the food chain.

All parts of the food chain depend on transport and thus fuel. Large parts are also characterised by the just-in-time principle, which means minimal stock at all stages. Much of the stored food products in Sweden are currently within the transport chain. This results in considerable vulnerability if something interferes with the normal flow. The capability to ensure the supply of food to consumers is very difficult on the basis of this scenario of fuel shortages.

There are specific strategies for how stakeholders can make existing food stocks last longer. For instance, managers at hospitals, nursing homes, and schools can change menus, although these measures are very limited and work for no more than a few days. Food stocks look very different within the chain. It is important to point out the difference in volumes between schools serving one meal a day and hospitals, care homes, and institutions serving all daily meals (full board).

In some places in the country, you can shop at the farms themselves, but this is far from the norm.

Impact assessment

The scenario will result in a major strain on society from day one of the incident. Disruption occurs at all stages of the food chain and consequently also for consumers, comprising every individual in the country.

Human life and health

No one in good general health and a stable social situation is expected to starve to death as a direct result of the incident. However, it is uncertain how the more vulnerable groups will fare. People in hospitals, care homes, and institutions are largely dependent on having all their meals arranged for them. These groups and people with limited or non-existent social networks are considered to be hit harder than others.

There is uncertainty about how much food people have at home. How much food each person needs depends, of course, on the individual. It is possible that an average person requires around 2,100 kcal/day, which is the proposed performance target for access to food. Many individuals would need more energy per day, while others would need less. If there is a lack of food, many would ration the food they have available to make it last longer. Living with a calorie intake below the performance target for a short period of time is not considered to result in serious injury/illness or death, apart from those already on the borderline.

In Sweden there is legislation on rationing. It is unclear, however, whether a rationing system would be desirable, and if so how quickly it could be launched. There is currently no technical system for this.

Society's functionality

Many areas of society depend on functioning transport. This scenario would immediately lead to considerable strain.

As mentioned above, over 40 per cent of the food consumed in Sweden is imported. Each year, around 400 million tonnes of goods are transported within the country, of which 35 million tonnes are made up of food and agricultural products. In the event of a fuel shortage, the ports will become full of goods as they cannot be transported further. Goods can be transported by train where there is a direct connection, but most goods have to be transported by truck at some point.

Fresh produce in grocery stores will quickly run out, while most industries are dependent on daily deliveries, which means that they will have to close.

When the total impact of transport disruption in the food sector is weighed together, it becomes clear that society would struggle to function.

Society would recover once deliveries recommence, but with potentially large geographical differences. Some special products could be affected by the disruption for several months.

Economic values and the environment

The cost to society is difficult to assess but could amount to several billion Swedish kronor, primarily as a result of a loss of production.

The long-term economic impact may affect farmers, among others. It will be difficult for farmers who already have tight profit margins. How the food industry will be affected is also uncertain. If the price of petrol remains at SEK 45 per litre and diesel at SEK 42 per litre as in this scenario, society will undergo a

structural transformation. It will take time before the balance in the food supply is restored. Whether prices remain at the same high level or not after the blockades have been lifted plays a role in how long we expect it to take for the food sector to return to the same level of functionality as before.

The economic impact may vary depending on the geographical differences in the country. For example, if prices remain high, it will be much more expensive to get to work in parts of the country where there is greater dependency on cars.

Democracy, rule of law, and human rights and freedoms

Lack of food in stores can lead to civil unrest. It may also result in hostility towards the blockades. There is expected to be extensive hoarding of food and fuel. This leads to shops and service stations being emptied faster than normal.

There is expected to be a widespread spreading of rumours via social media while the scenario is ongoing. In order to avoid the spreading of rumors, the authorities themselves should disseminate accurate information through social media and actively monitor developments in social media. The joint authority website krisinformation.se will also play an important role by helping to give the public a coherent message from stakeholders.

Protests directed against the authorities may arise. People may not be able to understand why the situation is not being resolved and may be frustrated that authorities "are doing nothing" to lift the blockades.

As a result of the incident, there may be discussions about the need for new laws or the revision of existing ones. This might include competition law and rationing legislation. New priority issues for critical infrastructure may also feature on the agenda – e.g. which stakeholders must always have access to fuel?

Probability

The background to this scenario has actually happened – a country in the Middle East has *threatened* to close a strategically and logistically key strait for oil exports. The reality of such a threat being actioned is, however, unlikely, as it would hit that nation just as hard as the rest of the world. In other words, it is far from certain that the market would take such a threat seriously. Fuel blockades have taken place several times in Europe, such as in France and the UK in 2000.

Sweden has no experience of extensive fuel blockades nor the same tradition of protests and blockades such as those organised by French farmers. In recent years, transport companies in Sweden have stated that they feel increasingly pressured mainly because of taxes and regulations. Since joining the European Union, costs have increased and profit margins have fallen sharply. To be able to offer competitive pricing levels, more and more companies have decided to reduce their costs by hiring foreign workers. This has contributed to increased competition and a "price war", with profit margins falling further as a result.

Uncertainty assessment

There is a high level of uncertainty in the impact assessment, especially with regard to estimates of how many people would die or be seriously injured or ill, the extent of the economic impact, and of the extent and effects of the spreading of rumours.

Sensitivity analysis

It is primarily the duration of the scenario and the extent of the strikes and blockades that govern the severity of the impact.

3.4.3 Capability to be developed

Since 2010, the Swedish National Food Agency has been responsible for the national co-ordination of emergency-preparedness planning for the food supply. The authority's work includes conducting studies and exercises. The Swedish National Food Agency and other authorities and stakeholders need to continue developing their efforts to ensure the robustness of the food supply. MSB's performance targets in this area can, for example, offer guidance as to the supply levels that need to be ensured.

The municipalities can get a good feeling for their priorities within their area of responsibility, but they are not the ones delivering the food. Co-operation is needed between the municipalities and the logistics managers of major food chains, or even at a higher level. The Swedish National Food Agency could facilitate such discussions. Co-operation must be proactive. Once the disaster has occurred, it is already too late.

The same applies to the possibility of allowing different stakeholders to distribute food to different parts of the country – e.g. Coop takes some regions and ICA others. They cannot reach such agreements themselves as this would violate competition legislation, although in a disaster situation the Swedish National Food Agency could be party to the discussions. Another method could be to redirect fuel from e.g. the construction sector to the food sector (note that only special trucks can transport food due to hygiene and temperature requirements). The requirement for redirection must come from the top, and there is a question mark over whether this is possible at all. During this situation, MSB would prepare documentation providing a basis for decisions based on national prioritisation.

3.5 Disruption to the supply of drinking water

Access to clean drinking water is one of the most important factors in the society. In addition to drinking water for survival, households need water for cooking, toilets, and showers. Hospitals are especially sensitive to interruptions to the water supply. Water is necessary for all food-handling and to maintain hygienic food production. Water is also needed for industries, offices, municipal operations, district heating, and rescue services.

There are many potential causes of disruption to the supply of drinking water, including heavy rain and the release of toxic substances. Disruption can occur both within distribution (the water does not get to where it needs to go) and in quality (the water is not drinkable). Each step of the drinking water chain also depends on electricity and IT to work. Electricity is required to maintain the functionality of the IT systems used to control and configure the drinking water chain.

Vulnerabilities in the supply of drinking water primarily exist at the waterworks, which do not have full electricity backup capacity, and the backup capacity they do have is only for operating the waterworks and not for the various needs of the distributions system. The capability to organise or bolster water supplies from neighbouring counties or municipalities is also sometimes lacking. Furthermore, the water supply situation is characterised by a marked seasonal variation both in terms of supply and demand, with a sharp increase in consumption during the summer when supply is at its worst. The Geological Survey of Sweden (SGU) has identified that many water conservation areas where groundwater extraction takes place lack contingency plans for the supply of drinking water and risk analyses for adverse incidents.

According to the Swedish National Food Agency's risk and vulnerability analysis for 2013, around 90 per cent of all households are connected to the municipal water system. This means that a very high proportion of permanent housing depends on municipal water and has few or no independent alternative solutions in disasters. The municipal drinking water system is usually made up of autonomous systems, which means that there are limited or no opportunities to link up to other drinking water systems. The Swedish National Food Agency assesses it is possible to supply drinking water by way of tanks (emergency water) in relatively large urban areas. This does require considerable effort, however. For large cities, this is considered a less realistic solution as the workload required is too extensive. This means that there is only a limited possibility of supplying the majority of municipalities with drinking water during a prolonged outage.

Some counties lack adequate backup water-supply sources, while some municipalities lack adequate protection against parasites (UV light) in water intakes. The Swedish National Food Agency states that the major producers of drinking water often have limited access to other water intakes, and that work to establish new water intakes is a very time-consuming process which can take several years to complete and cost hundreds of millions of Swedish kronor. For a major city, the cost can run into the billions. Furthermore, many water intakes lack a water conservation area classification, and in some cases raw water intakes are located close to major transport routes, which carries a risk of contamination in the event of serious transport accidents.

Long-term problems include climate change, which threatens to have an adverse effect on raw water quality. Additionally, it is emphasised that the water supply and sewer system infrastructures are old. There have not always been adequate economic provisions made for improvement, which risks future problems occurring. In addition, water supply and sewer system businesses struggle to recruit skilled staff due to a lack of water supply and sewer system engineers. This trend also demonstrates that many people are depending on fewer facilities when municipalities reorganise and streamline their operations. This type of rationalisation is a vulnerability in itself.

The scenario analysed addresses Lake Mälaren, which is a drinking water intake for 1.7 million people in the Stockholm region from which three companies (Norrvatten, Stockholm Vatten, and Telge Nät) provide drinking water to the majority of the county's municipalities and two municipalities in another county. Three major waterworks (Görväln, Lovö, and Norsborg) account for about 90 per cent of the county's public water supply.

An incident similar to this scenario occurred in 1986 when parts of Lake Mälaren were polluted by an oil spill in the shipping channel between the Beckholm Strait and Kanan. The spill was estimated to be 250 litres and consisted of both heating oil and petrol, most likely from a cargo ship. The contamination was discovered by an individual who contacted SOS Alarm after detecting a strong smell of oil in the seawater. Raw water intake at the Norsborg waterworks was then reduced to a minimum.

3.5.1 Responsibilities

Most people in Sweden depend on the municipal water system for their supply of drinking water. A great responsibility therefore rests on the municipality to ensure that its systems are robust and to reduce vulnerabilities. The Swedish National Food Agency is responsible for co-ordinating drinking water issues and has developed regulations for drinking water and guidance for their application. In addition, there is a national network for drinking water with the aim of contributing to safe

drinking water, particularly in light of future challenges from climate change. In addition to the Swedish National Food Agency, this analysis also includes the National Board of Housing, Building and Planning, the Public Health Agency of Sweden, the Swedish Agency for Marine and Water Management, the county administrative boards, the water authorities, the Geological Survey of Sweden (SGU), the industry organisation the Swedish Water & Wastewater Association, and the Swedish Association of Local Authorities and Regions (SKL). Other authorities and organisations are active within various working groups.

During or prior to a disruption to the supply of drinking water, the municipality (municipal association or company) has a major responsibility as the producer and distributor of drinking water. The Swedish National Food Agency's co-ordinating role pursuant to the above includes disaster and emergency preparedness-planning relating to the supply of drinking water. The Swedish National Food Agency also administers VAKA (the national water disaster group), which serves as a support for municipalities and regions affected or which may be affected by problems in the supply of drinking water. The group consists of representatives from drinking water producers, environmental protection, laboratory activities, and the rescue services. MSB can assist in supporting co-operation (implementation of co-operation conferences), developing status reports, and co-ordinating information.

3.5.2 Scenario analysis: Diesel in the supply of drinking water

The analysis was conducted in 2012 and is based in part on a workshop, arranged by the county administrative board of Stockholm county together with the Swedish National Food Agency and MSB, with representatives from 22 of the 26 municipalities and the association of municipalities in the county of Stockholm[39], the Swedish Coast Guard, Norrvatten, Roslagsvatten AB, Stockholm Vatten, the Stockholm County Council, Swedavia, Sveriges Radio, Södertörn fire prevention association, and Telge Nät AB. The results were agreed primarily with the county administrative board of Stockholm county, Stockholm Vatten, Norrvatten, and the municipalities of Vallentuna and Österåker.[40]

Scenario

A cloudy weekday afternoon in February with heavy snowfall and a temperature of a few degrees below zero.

Geographic location

The scenario plays out in the county of Stockholm.

Sequence of events

A larger vessel carrying diesel runs aground near the intake to Görväln waterworks at Skeftingeholmen in Järfälla. Large quantities of diesel spill out into the water. For some reason the staff at the waterworks are not informed about the accident and contaminated raw water is pumped into the treatment process.

39. The following municipalities were represented: Danderyd, Ekerö, Haninge, Huddinge, Järfälla, Lidingö stad, Norrtälje, Nykvarn, Nynäshamn, Salem, Sigtuna, Sollentuna, Solna stad, Stockholm stad, Sundbybergs stad, Södertälje, Tyresö, Täby, Upplands-Bro, Upplands Väsby, Vallentuna, and Österåker.
40. This scenario was further developed on the basis of the drinking water scenario relating to Stockholm county developed by MSB for the special capability assessment in 2012 in close co-operation with the county administrative board of Stockholm, Stockholm Vatten, and Norrvatten.

After around three hours, water contaminated with diesel passes through the waterworks unnoticed and is released into the pipe network supplying more than half a million people with water in 13 municipalities. The water is not a health hazard, but it smells and tastes of diesel, making it unfit for drinking. It can, however, be used for toilets and other purposes not requiring water of drinking quality.

There are many sites in the area that are particularly sensitive to a loss of drinking water, including hospitals, prisons, nursing homes, and livestock farms. The treatment process at the Görväln works includes permanently active carbon filters, and staff can treat water contaminated with diesel using powdered carbon as soon as they discover the contamination. The decontamination of the environment is hampered by the winter weather, darkness, cold, and ice.

Capability analysis

Of the roughly 2 million people living in the county of Stockholm, around 1.9 million are supplied with drinking water by way of a public water supply. Every day, each person in the county uses an average of 235 litres of water, of which 190 litres is used by each person at home. Only around 5 per cent (or 100,000) of the county's residents have a private supply of water in the form of a private well or shared facility.

The quality and safety of the region's water supply is good, but the fact that the county's public water supply is totally dependent on the eastern part of Lake Mälaren represents an obvious vulnerability. The impact on society depends on how high the diesel content of the drinking water is. As soon as the drinking water starts to smell of diesel, it is rendered undrinkable by the Swedish National Food Agency, although it is not immediately hazardous to health.

Norrvatten, which runs the Görväln works, supplies an area of about 800,000 people. Since the Stockholm area has several waterworks, the impact of disruption to one of them can be limited as the other works can produce and supply extra water at least to some extent.

The fact that water cannot be drunk as normal poses a challenge in terms of information, because how the flow enters the municipality is more obvious than how the flow goes from the municipality to citizens. There are several channels that can be used, and the co-ordination of stakeholders who disseminate information becomes crucial. It is important that the public are not given mixed messages. MSB will, on the premise that stakeholders will share their information and assessment of the situation in their areas of responsibility, establish and continually update an overall national status report. The status report provides a cross-sectoral description of the impact, the disaster-management measures, and the need for co-ordination. It is intended to strengthen the joint action of stakeholders at the national level and may serve as a basis for prioritisation. The joint authority website krisinformation.se should be used to give the public a coherent message from stakeholders.

Impact assessment

Human life and health

The assessment is that the scenario won't lead to any fatalities lead and that the majority of the population within the water distribution area will not fall ill.

Society's functionality

The scenario would entail a major impact on health and medical care and social care. There would be a need for a supply of emergency water to hospitals, assisted living facilities, and other institutions. Other vulnerable groups in society include those suffering from demential, the mentally ill, the disabled, children, and the elderly.

The scenario would have a direct impact on agriculture and food production. There is currently no information on how many farmers and stall owners in the county have access to their own well.

The sewage system, district heating, and waste systems are considered to function during the scenario period.

Economic values and the environment

The economic impact of the scenario is expected to be limited. Lake Mälaren's value as a drinking water resource is very high, however. The production of drinking water was valued at SEK 2 billion per year during the analysis, and more protracted incidents than the one in this scenario could have a major economic impact.

Democracy, rule of law, and human rights and freedoms

This scenario would result in people starting to look for alternative sources of drinking water. It is likely that people will start hoarding bottled water from grocery stores. Looting could also occur if the incident is not managed properly.

Rumours are expected to spread widely in society, with regard to both the cause of the disruption (conspiracy theories) and where to get hold of drinking water.

Probability

The probability of this exact scenario occurring depends on a number of crucial associated incidents:

- A cargo ship carrying diesel runs aground close enough to the raw water intake for the Görväln works. The staff at the works do not detect and are not informed of the accident by the authorities responsible.
- The diesel-contaminated water enters the waterworks' production process unnoticed.
- Diesel passes through the purification process without being detected and drinking water contaminated with diesel is released into the pipe network.

In the unlikely event that the staff of the Görväln works remain unaware of the accident of a large ship nearby, they are still likely to detect the diesel immediately once it enters the waterworks on account of its distinctive smell. They would then add powdered carbon to dilute the diesel in the drinking water to levels undetectable by smell or taste.

If the diesel was not detected initially and still entered the waterworks' system, it is still highly likely that it would be detected within two hours, when it would still be possible to add powdered carbon before the contaminated water was released into the pipe network.

Uncertainty assessment

There is a low level of uncertainty in the assessments, largely on account of the considerable experience provided by the participants in the analysis and by experts from the water authorities in Stockholm county.

Sensitivity analysis

The impact on society depends on how high the diesel content of the drinking water is. If the scenario involved a pollutant other than diesel, the impact could be completely different.

More extensive and more prolonged disruption or the occurrence of another incident at the same time would also result in a more serious scenario.

3.5.3 Capability to be developed

There is a need for a proactive, collective approach to drinking water issues. On 18 July 2013 the government decided (dir. 2013:75) to appoint a special investigator to review the area of drinking water, from raw water to taps for public drinking water, with the aim of identifying current and potential challenges to the safe supply of drinking water in the country, in both the short and the long term. The investigation will continue until 29 April 2016.

The capabilities of society (both counties and sectors) in the event of an outage with regard to the need for backup water-supply sources or emergency water[41] vary but are often inadequate. Stockholm county, for example, has a very limited emergency water capability in relation to the number of inhabitants. The supply of emergency water should be prioritised to certain vulnerable groups for whom a shortage could pose a danger to life and health or where the shortage could have a serious impact on the society's functionality which these groups depend on. During this situation, if needed, MSB should prepare documentation providing a basis for decisions based on national prioritisation.

The stakeholders responsible should ensure access to drinking water by way of backup water-supply sources or emergency water. The stakeholders responsible should also continue to develop and systematically practise procedures for the use of backup water-supply sources and emergency water for critical infrastructure.

3.6 Disruptions in the transport system

Transportation is a broad concept and includes not only physical transport but also covers infrastructure, traffic management and operation, and the provision of services. Serious transport disruption or disruption to a transport hub, such as a port or airport, may have a devastating impact on society.

In the transport sector there is a high level of internal dependence both between models of transport and between infrastructures and vehicles within each mode of transport. A transport chain from supplier to customer may include all modes of transport, and the vast majority of rail and sea transport also includes some form of transport by road.

Many other vital societal functions are critically dependent on functioning transport – e.g. district heating, food supply, emergency medical care, elderly care, food distribution, and newspapers. Other activities that are clearly dependent

41. Mergency water means the supply of water for drinking, cooking, and personal hygiene without using the regular pipe network (e.g. tanks or tankers).

on transport include the rescue services, electronic communications, power supply, and primary care.

In addition, companies with their own vehicles are clearly dependent on a functioning transport infrastructure – e.g. the passability of the roads. This applies to the transporting of cash, the police, the rescue services, security services, emergency medical care, elderly care, and the mass media, as well as to repairs to the power supply, electronic communications, and district heating.[42]

No scenario analysis with a focus on disruption to transport has thus far been conducted within the framework of the national risk and capability assessment.

3.7 Disruption to the supply of drugs

One vulnerability often identified in the authorities' risk and vulnerability analyses is access to drugs. A lack of consideration for emergency-preparedness aspects in agreements in combination with a reliance on just-in-time drugs (i.e. no stock) has made this vulnerability greater. Several authorities describe the vulnerability by citing that there are no local stocks at pharmacies or wholesalers. The deregulation of the pharmacy market in Sweden has been considered a potential cause of the occurrence of potential drug shortages, in that co-operation between competing pharmacies is not feasible and that the flow of information on drug availability is not transparent.

Sweden has no domestic production of vaccines and very little by way of drug production and is thus dependent on imports. In the event of a serious contagion, there is also a risk of a lack of medical supplies and other health-care equipment.

Disruption to deliveries represents a potential risk in the supply of drugs, especially as many countries require a certain drug at the same time. Drugs in Sweden are primarily transported from other neighbouring European countries, and even though drugs are produced in Sweden, the country depends on imports of drugs produced abroad. Disruption to deliveries can result in a general lack of drugs that are rarely produced or which are in low demand but may be vital for certain patient groups. The 2009 pandemic flu is an example of an incident in Sweden that demonstrates the dependence on foreign drug production and the importance of effective vaccine supplies.

No scenario analysis with a focus on disruption to the supply of drugs has thus far been conducted within the framework of the national risk and capability assessment.

42. Swedish Civil Contingencies Agency, *Faller en – faller då alla? En slutredovisning från KBM:s arbete med samhällskritiska beroenden*, (*If one falls – will they all fall? A final report from the Swedish Emergency Management Agency's work on critical societal dependencies*), MSB 0001-09, 2009.

Antagonistic hazards

4. Antagonistic hazards

Antagonistic hazards are defined as incidents that have deliberately been caused by humans. Examples of antagonistic hazards include cyber-attacks, terrorism, extreme violence, and social unrest.

4.1 Cyber-attacks

IT systems are becoming increasingly integrated into society and our daily lives. Many of the features that we use in daily life are automated and digitised in IT systems. In many cases, this makes our daily lives more efficient and makes it easier for us to find information, manage data, communicate, and make decisions. IT systems knows no geographic boundaries and can quickly and precisely manage and process enormous volumes of data. The downside of this and the risk it poses is that the negative impact which may arise from defects quickly can become very extensive.

The expression "cyber-attack" can be described as a comprehensive attack against information systems or networks. The individual carrying out these attacks may do so with the intention of causing destruction, but they may also be seeking to access or manipulate information. The reasons for cyber-attacks can be dissatisfaction, organised crime, terrorism, or other political motivations. They can target a state, organisations, or individuals.

Sweden has so far not been affected by any major IT incidents that have overwhelmed society. However, smaller online attacks and attempted attacks occur on a relatively regular basis against Swedish authorities and other public organisations. These often relate to grievances directed against targets of symbolic value. The effects are usually temporary, and potential impacts have been minor in comparison with the attention given to the attacks.

For example, the Swedish government and the Swedish Police Authority have had their websites subjected to attacks on several occations. These attacks have aspired to block and deny users certain webbased services.

There have also been reports of intrusions into industrial information and control systems (known as SCADA systems). In these cases the attacker has carried out the intrusion for the sake of the action itself rather than with any specific intent. This demonstrates that SCADA systems contain vulnerabilities that can be exploited. An example of an intrusion into a SCADA system is the attack against the web application controlling the heating in 700 households and a business centre in the city of Motala. On this occasion, an attacker reduced the nighttime temperature in these buildings, but the attack was discovered in the morning after and there was no lasting damage. Most of the homeowners never noticed the attack.

Intrusions that are carried out in order to steal data are not always discovered, and in those cases when they are discovered, the intrusion may have been carried out over a long period of time. One such example is the attack against Logica's mainframe computer in 2012, which lasted for more than two years before being discovered. According to a police investigation, large volumes of personal data have been stolen from the company Bisnode. Furthermore, data have been copied from the Swedish Tax Agency, the Swedish Police Authority, and the Swedish Enforcement Authority.

There are several possible reasons why the number of reported attacks is so low. Firstly, it can be difficult to distinguish between an attack natural system errors. Espionage and data theft does not always leave obvious traces. It becomes clearer if an attacker wants to control or destroy the system under attack. Another possibility is that Sweden has no law that compels the authorities and organisations to report cyber-attacks against critical infrastructure, which does exist in e.g. most US states.

No scenario analysis with a focus on cyber-attacks has thus far been conducted within the framework of the national risk and capability assessment.

4.2 Terrorism

Terrorism can take many forms. Attacks involving bombs or firearms have been almost completely predominant up to this date.

Global terrorism has been a growing concern, with an increasing number of people killed and wounded during the 2000s. The United States and Western Europe are the parts of the world that have been least affected by terrorism during this period, despite several very serious incidents. Terrorism can take many forms.

Since 2010, the Swedish security police (Säpo) have raised the terrorist threat-level to a three on a five degree scale. In other words, the threat assesement have gone from 'low threat' to an 'elevated threat'.

A SELECTION OF TERRORISM CASES IN SWEDEN WITH A CONNECTION TO SWEDEN OR IN PROXIMITY TO SWEDEN

2015	Attack on a cultural centre in Copenhagen – two people, the attacker died – Five police officers were also injured.
2015	Attack on Charlie Hebdo (Paris, France) – 12 members of Charlie Hebdo staff killed, one police officer killed during the pursuit, and four people killed during a hostage drama.
2011	Attack in Oslo and on the island of Utøya (Norway) – 77 dead and at least 319 injured.
2010	Prevention of the planned attack against the Jyllands-Posten newspaper in Copenhagen.
2010	Suicide attack at the corner of the Olof Palmes gata and Bryggargatan in central Stockholm – one dead (the attacker).
2002	Attack on a nightclub on the Indonesian island of Bali – 202 killed, including six Swedish citizens.
1985	Planning and execution of attacks in Copenhagen and Amsterdam – one dead and 27 injured.
1975	Attack against the West German embassy – four dead (including two attackers) and 14 injured.

4.2.1 Responsibilities

There are a number of authorities and stakeholders responsible for and tasked with preventing terrorism in Sweden. Many of these are gathered under the umbrella of the Counter-Terrorism Cooperative Council – a partnership between fourteen Swedish authorities[43] – created on the initiative of Säpo in 2005. The Council seeks to pursue long-term strategic work to strengthen Sweden's capability to counter terrorism. Its work builds upon the EU's strategy for countering terrorism and the government's national strategy for dealing with the threat posed by terrorism.

43. Apart from the Swedish Security Service, the council comprises the Swedish Police Authority, the Swedish Armed Forces, the National Defence Radio Establishment, the Swedish Defence Research Agency, the Swedish Civil Contingencies Agency (MSB), the Swedish Coast Guard, Swedish Customs, the Swedish Economic Crime Authority, the Swedish Migration Agency, the Swedish Radiation Safety Authority, the Swedish Prison and Probation Service, the Swedish Prosecution Authority, and the Swedish Transport Agency.

There are more stakeholders involved in the event of an actual incident, either in responding to the incident or by being indirectly affected by its impact.

4.2.2 Scenario analysis: Bomb attack

This analysis was conducted in 2013 and is largely based on a workshop with representatives from relevant stakeholders.

Scenario

The scenario begins on a Saturday in early June.

Geographic location

The scenario takes place in Stockholm in the Sergels torg square and the adjacent central metro station T-Centralen. It is 22 degrees, the sun is shining, and there is no wind.

Sequence of events

The fine weather means that approximately 300 people – tourists, weekend shoppers, metro users, and so on – are in or directly adjacent to Sergels torg.

On Saturday 8 June at 13:02 an explosive is detonated in a van outside the SL Center in Sergels torg in Stockholm city centre. Eleven people are instantly killed by the car bomb blast, while 23 are seriously injured and 41 are slightly injured. The explosion causes the entire entrance to T-Centralen from Sergels torg to collapse, which means that it is impossible to get in or out by that route.

At 13:14, two people detonate "rucksack bombs" in a metro train that has just come to stop at the T-Centralen platform. 88 people are immediately killed. 157 people are seriously injured and around 500 people suffer minor injuries. Many people are suffering from serious mental shock.

At 13:25 a terrorist group based in country X claims responsibility for both attacks. On 13 June Swedish police arrest three men and a woman on suspicion of being accomplices to the attackers.

Capability analysis

The capability to respond to a terrorist act of this kind will be very challenging, despite good basic prerequisites existing among the affected stakeholders. The police, rescue services, and health-care sector have plans, structures, and procedures in place to be rapidly deployed and to scale up their respective organisations based on needs in the initial stage. The equivalent planning, structures, and procedures also exist for other stakeholders who are responsible for dealing with the further impact of the incident – e.g. other elements of the Swedish Police Authority, SÄPO, MSB, and many more.

In practice, it will be difficult to determine during the initial course of events whether it is a case of an accident or a terrorist act. Unless it is possible to confirm at an early stage that it is a terrorist act and respond on this basis, further management may be delayed. Sweden has not yet been hit by a terrorist incident with mass casualties. It is uncertain to what extent there is mental preparedness for the fact that an incident such as a powerful explosion may constitute a terrorist act that in turn may be followed by several other acts in the same location or elsewhere. Status reports as the situation unfolds following the explosions will probably continue to be characterised by confusion and uncertainty throughout the whole initial course of events.

The Swedish Police Authority, rescue services, and health-care professionals should co-operate at the external management point to determine how their joint efforts can best be implemented. T-Centralen and the metro are both extremely difficult sites to work at given their large areas and tunnels at different depths, as well as the large number of people there at the same time. The explosion and any subsequent fires also result in extensive smoke and a resultant mass evacuation, which further complicates and delays the evacuation of injured people and the cordoning off of the area by the police. The rescue services may have to await the arrival of the police to "secure" the area prior to carrying out their duties. The police in turn may find it difficult to secure the area due to its being a complicated location, and there may be smoke (or other hazardous gases). These are aggravating factors that may lead to even further deaths and injuries.

This type of terrorist incident is of such a magnitude that extensive co-operation between authorities will be necessitated – not only domestically but also internationally. This may include the exchange of intelligence, medical support, or transportation. Even in this case, there is a good foundation for success – for instance, in the shape of regional co-operative initiatives led by the county administrative board or national initiatives led by MSB. Initially it will probably be very difficult for the authorities to obtain a comprehensive overview of the situation due to its chaotic nature. The work will initially be highly organisational in nature, while co-operation will be key to the management of the terrorist incident. The pressure of the mass media on the authorities will be substantial and demanding.

The police will almost certainly decide to stop all metro traffic, evacuate all metro trains, and cordon off sections of the road and rail networks. A large area around T-Centralen and Sergels torg will be cordoned off and 10,000–50,000 people will have to be evacuated from the area in the short term until the area around the blast site is deemed safe.

Health and medical care will be under significant strain during the management of the incident. The capability within health care to prioritise and take care of injured people (including the freeing-up of hospital beds, the need for specialist skills in both the short and long term, medicines, blood, helicopter transportation, etc.) is critical.

In this scenario the work of the Government Offices of Sweden and the government will be focussed on following the course of events and supporting the affected authorities in their work. The overall national status report prepared by MSB in co-operation with affected stakeholders will be an important basis for this. Additionally, the prime minister and affected ministers will probably on a number of occasions during and after the acute phase of events publicly address the public as well as the Swedish and international media. All this in order to reassure the public and to help to maintain public faith in the authorities' management of the terrorist incidents.

For the Swedish Police Authority, as well as for other authorities, it is difficult to determine when the transition from post-incident management to a normal situation occurs. It is impossible to be certain that there will not be further attacks in connection with the incident. This differs from incidents where there is no antagonist involved, where it is ordinarily easier to identify an ending. It is also of great importance that clarity is provided as to who the perpetrators are. Furthermore that all perpetrators involved are arrested and prosecuted in order to avoid any permanent insecurity in society and to bring the incident to a close. It is also important to help maintain the public's faith in the authorities' capability to respond to new terrorist threats.

Impact assessment

Human life and health

The scenario shows that a total of 99 people die as a direct result of the explosions, while 180 people are seriously injured and 541 people suffer minor injuries.

Considering how many people are normally in the area surrounding Sergels torg and on the metro, as well as the intensity of the explosions, further casualties are not an impossibility. As is the case of other tough operating environments, the difficult conditions on the metro mean that it will take a long time for all casualties to begin to receive care in hospital. This means there is a risk that the number of fatalities may rise.

More of the people located in the metro than those initially injured will be affected by the bombs – e.g. due to smoke and difficulties escaping from the tunnels, in part because the lighting is not working. There is also a risk that there will be overcrowding as survivors attempt to escape, and that people may be injured or crushed to death. The fact that it may take some time before the rescue services can begin to work inside the metro may result in more people dying at the scene. Delayed ambulances, a lack of space in hospitals, and postponed operations may also lead to further deaths.

Anxiety and insecurity are likely to impact more than just those directly affected and their loved ones. There will be many people who witness thebomb attack and may suffer psychological trauma as a result of theexperience. These also include personnel from the police and rescue services who are also likely to suffer from psychological difficulties due to what they have witnessed at the scene. Psychosocial care may be extensive and may be required for a long period of time.

Society's functionality

The mass casualty outcome will result in a substantial level of demand for health-care services throughout the Stockholm region. The increased demand for health-care services due to the terrorist attack will also have a negative impact on ordinary health care. The focus will be on life-saving operations. It will probably take months before any type of normality returns. There will be a very great need for trauma expertise and psychosocial skills. Extensive co-operation will be required between county councils in order to cope with the large number of seriously injured people. Decisions will need to be made about how to divide the injured among the hospitals in the region.

Rail traffic through Stockholm will be affected, either through complete suspension or in that trains will be permitted to run through the central station without stopping. It is estimated that around 500,000 people pass through the system connected to the central station on a daily basis. The incident will lead to more people choosing alternative routes and other modes of transportation. There is strong symbolism in rapidly returning to normal after an incident. The stakeholders responsible will work intensively to get public transport back up and running as quickly as possible for the reason of symbolism outlined above, as well as for economic and practical reasons. Following the bomb attacks on the London underground in June 2005, there was initially a fear of using public transport, but this passed fairly quickly. By the end of the holiday period, the number of passengers using the underground and public transport had returned to the levels seen prior to the suicide bombings.

The load on the mobile phone network is likely to be high with immediate effect following the incident. There is also a risk that the Rakel communication system will not fully function when a large number of devices are in use in a very limited

area. However, Rakel does have a very high capacity in central Stockholm. These types of interruption can be very disruptive but only occur for a limited period following the incident.

Economic values and the environment

The explosions will damage the surrounding buildings, primarily in the form of the blast smashing windows. Damage to structures, including cracks in nearby roads, may also occur. The costs for the reconstruction and repair of buildings and infrastructure will be significant. In 1996 in London a lorry bomb was detonated outside a large office complex. In that case the value of the damaged buildings was assessed as GBP 170 million (around SEK 1.9 billion).

In addition to this, there are also the costs of compensation to those injured and the victims of the incident to be considered, as well as business activities that cannot be conducted in the same way as before. Losses may also occur in connection with people off work, transportation failures, and delays to goods.

There are also the forthcoming costs of investigation, extra judicial and police resources, trial expenses, and much more. However, these are short-term costs.

As in Norway after the terrorist attack in 2011, psychosocial support will be needed by many people for a long time to come, which means high costs for the affected municipalities.

There will also be additional costs in private companies, insurance companies, and others, and share prices may be affected with the Swedish krona being weakened. The length of disruption to transportation will also impact overall costs. If traffic through Stockholm is suspended, it will have a drastic impact on both regional and national traffic.

A rough estimate based on the above reasoning is that costs during the first year after the incident would be somewhere in the range of SEK 1–10 billion.

Democracy, rule of law, and human rights and freedoms

Just a few days after the incident there will probably be protests against terrorism, which may be widely supported by many people.

It is likely that many rumours and a great deal fragmentary information will flourish following the incident. In this respect, the manner in which public stakeholders provide information will be crucial. There will be significant discussion prior to the arrest of the perpetrators, as well as discussion of the way the authorities are handling the situation. There will be a lot of guessing and speculation. The international media will also pay attention to the incident and disseminate information. However, it is highly uncertain whether this will have an especially negative (or positive) impact, beyond the rumours.

Confidence in the authorities involved in managing the incident might be affected negatively by the incident in the scenario. This depends largely on how successful they are in managing the situation and how they keep the public informed. It will be particularly difficult if the police and rescue services at the scene are perceived to be passive due to the tough working environment in the metro causing delays in the operation. The 22 July Commission's review of the incident at Utøya in 2011 reports that when public stakeholders were obliged to wait for confirmation of whether it was safe for the ambulances to approach and start rescue operations on Utøya, activity among civilian volunteers was even higher. This was among the several issues that the authorities were later criticised for.

Probability

Historically, Sweden has been relatively free from attacks, but in 2010 there was a failed suicide attack in central Stockholm and preparations for a major terrorist attack in Denmark took place in Sweden. As is clear from the background information, terrorist attacks have recently taken place in Europe and have even occurred in neighbouring Denmark and Norway. The fact that the threat level assessment has been heightened since 2010 is also an indicator that the probability of a terrorist event is elevated.

Uncertainty assessment

There is no doubt that the metro is a difficult operating environment. However, there is uncertainty surrounding management and whether this is to be treated as a terrorist attack from an early stage. It is largely dependent on the initial status report and also on the people who first receive this information. This is difficult to determine in this type of scenario analysis.

With regard to economic impact, there is a high level of uncertainty. No deeper analysis of costs has been carried out, but comparisons with Norway demonstrate the order of magnitude.

Sensitivity analysis

With regard to the design of the scenario, the type of bomb and the selection of the scenario's geographic location are crucial in determining the significance of the outcome. The presence (or absence) of a CBRNE component in the bomb would be crucial to both the outcome and subsequent management of the situation. Sergels torg and the Stockholm metro are highly complex sites for carrying out rescue operations. Other factors that have an impact are the assumption of how many people there are in and around the attack locations, the day of the week, and the time of day.

The time of year in which the scenario occurs may also be significant in terms of the number of injuries. If the scenario had taken place during winter, the number of injuries might have been even greater since the state of the seriously injured people and those in shock can rapidly deteriorate if they remain in the cold. In winter there are probably fewer people outside in Sergels torg, but more people may choose the metro as their mode of transport.

4.2.3 Capability to be developed

Preventative efforts

A number of assumptions have been made in the development of the above scenario. Firstly, it is assumed that the attackers are able to plan and carry out the attack without being detected. Secondly, a van is able to drive into Sergels torg and park in central Stockholm without there being time for police or security guard intervention. Finally, two people are able to carry explosives in rucksacks through the ticket barriers on the metro and take a train.

The above are examples of situations and incidents that can, through proactive intelligence and security and police work, be dealt with, thereby preventing a terrorist attack and the associated impact. Within the framework of this assessment, there is no opportunity to describe the current state of this type of work, to what extent it needs to be developed, and how this can be done.

Furthermore, a terrorist attack and the deliberate action behind it are clear examples of how important it is to work on the more fundamental causes of the act itself. Work of this kind involves the concerted efforts of various stakeholders in society and may involve providing support to people who have been caught up in extreme environments that promote violence.

Management (preparatory) work

It is very important that there are pre-established plans and procedures for how an organisation will work during a disaster, but above all it is important that these plans and procedures are followed according to the motto ”plans are the basis for improvisation”. Plans and exercises must aim to ensure that there is certainty that individual employees and organisations will act in the correct manner. The 22 July Commission’s report states that in several cases there were plans in place intended for disasters that were not activated. The Commission believes that this (at least in relation to the police decision not to activate the plans) delayed the response to the incidents.

In preparing this analysis it was highlighted that when the attack on Bryggargatan occurred in 2010, many people were mentally unprepared for the fact that this could happen in Sweden, both within many Swedish authorities and within the population as a whole. Since then there have been several exercises with elements of terror management, including under the auspices of the Counter-Terrorism Cooperative Council. In February 2013, after reviewing the 22 July Commission’s work in Norway, the National Criminal Police, the National Police Board, the Stockholm Police, and SÄPO jointly noted that there remains a great need for further training activities in Sweden.

4.3 School shooting

So-called school shootings are a form of extreme violence in the school environment where students or staff are subjected to violence with firearms. The school shooting in Bath, Michigan, USA (1927) remains the worst incident in history with 45 deaths, while 15 people lost their lives in the highly publicised Columbine massacre outside of Denver in 1999. Finland has been hit by two school shootings, in Tuusula (Jokela School in 2007) and Kauhajoki (local unit of Seinäjoki Polytechnic in 2008), where eight and 11 people were killed respectively. In 1961 there was a school shooting in Sweden at Kungälv secondary grammar school resulting in one fatality and six wounded. In Malmö in 2004 a 16-year-old student was prevented from carrying out a planned massacre and there have been several cases of threats of violence against schools in, among other places, Eskilstuna, Örebro, and Piteå.

The technical term used by the police to describe school shootings is “ongoing deadly violence in a school”.

4.3.1 Responsibilities

No single stakeholder is solely responsible for school shootings and similar acts. Responsibility for catching potential attackers and preventing attacks from being carried out rests with multiple stakeholders in society as a whole, including stakeholders in public administrations such as schools.

In the event of an incident, the affected school, the municipality, the rescue services, the Swedish Police Authority, and the health-care sector will all have significant roles of responsibility. MSB can assist in supporting co-operation (implementation of co-operation conferences), developing status reports, and co-ordinating information.

4.3.2 Scenario analysis: School shooting

This analysis was conducted in 2012 and is based to a great extent on an expert workshop with representatives from the Ministry of Education and Research, the Swedish National Agency for Education, the National Board of Health and Welfare, the County Administrative Board of Skåne County, the police in Skåne and Stockholm Counties, Skåne County Council / Region Skåne (disaster medicine), two municipalities (rescue services, disaster management / support functions, and the school head teacher), Malmö University, and crisis communicators from MSB. The scenario was checked beforehand with representatives of the police, a county administrative board, and a municipality.

Scenario

The scenario begins on a Wednesday in mid-December.

Sequence of events

The scenario takes place in a fictional town and the seat of a fictitious municipality in western Skåne with approximately 30,000 inhabitants.

Capability analysis

An 18-year-old student unexpectedly starts shooting at students and staff on a weekday morning at a secondary school in a municipality with 30,000 inhabitants. The shooting continues for 7–8 minutes before the first police patrol arrives. The attacker barricades himself into the school building and continues shooting, including at people in the surrounding area. The police are therefore forced to retreat. Police cordons are established and it is ensured that those fleeing the school building reach safety. A task force searches the school building and finds the attacker in a classroom after one and a half hours. He is unconscious and has a gunshot wound to the head following a suicide attempt.

Beyond the cordons there are groups of confused and crying students. They are taken care of by the police and health-care and school staff, as well as by relatives hurrying to the scene after being informed of the incident.

There is substantial pressure from the media and the public, who want to find out more about the incident. On social media there is an extensive and ongoing exchange of accurate information and rumours. There are a total of seven fatalities from the school shooting – one teacher and six students. An additional two students suffer minor gunshot wounds and a further five students and one teacher suffer minor injuries during their escape from the school. The attacker later dies as a result of his gunshot wound.

Capability analysis

Both the police and the rescue services will be engaged in the emergency phase of this incident. The police will have a heavy workload during the school shooting and for a period directly afterwards, but the police should not suffer from any form of overload. The work load is manageable within the framework of the regional police organisation's normal structure. The rescue services will provide support to the police as well as medical care by taking care of casualties on the scene and constructing a rear command post. The rescue services will also support the municipality in initiating its disaster management structure and supporting this. The rescue services' structure will not be overloaded.

Health and medical care as well as social care have the capacity to manage the casualties using their ordinary resources. The exception to this may be psychiatric care, where the situation is more difficult to assess. The ordinary workload in psychiatric care may increase markedly in connection with this type of social trauma as there may be repercussions in the wider population. Experience from Finland also shows that this type of incident creates a national shortage of psychologists for one year.

Disruption is to be expected primarily in the school system and the affected municipality. There will initially be an enormous amount of pressure on the municipality. Key stakeholders at the national level will require information about what is happening and what measures have been implemented. The municipality is expected to undertake measures to activate disaster staff and central disaster management/disaster management committees in the affected community. The media and public should contact the municipality with questions and requirements concerning the municipality's actions. The priority of municipal operations that are not directly relevant to managing the incident should be downgraded.

Impact assessment

Human life and health

The scenario leads to the deaths of seven young people, one adult and the attacker. Two young people suffer gunshot wounds but suffer no permanent physical injuries. A handful of young people suffer minor injuries in the form of cuts and so on.

In terms of psychological issues, a school shooting witnessed by 100 young people can result in an estimated 25 of them suffering from chronic psychological disorders. Psychological issues may also have an impact on the families of affected school children. One estimate is that for each person affected by a traumatic incident, there are four relatives who require some kind of disaster support in either the short or the long term.

In this scenario, it is estimated that 500 to 2,500 people will suffer from psychological issues on an immediate basis during the management of the incident and in the year following the incident. These people may need to be observed for some time to ensure that they do not require care, as well as being protected from the media and potentially from scientific monitoring.

Society's functionality

The school shooting in the scenario will marginally affect the society's functionality. Information and communication may be affected during the first hours because of the local mobile phone network going down due to overload. The municipality's telephone exchange may not work on a temporary basis for the same reason.

The main disruption should be anticipated in the school system. The school in question will be closed for a period of time to permit an examination of the crime scene, and the number of teachers and other school staff who are on sick leave may increase. Students' schooling may also be affected if teaching does not quickly recommence.

Economic values and the environment

The social costs of a school shooting are difficult to assess. However, it may well amount to a sum of several million Swedish kronor over a period of several years. Apart from direct damage that may occur in the school building in the form of bullet holes in walls, smashed windows, etc., there may be additional costs to cover alternative school premises while the school building is closed to allow for examination of the crime scene and any necessary repairs.

Based on experiences from Finnish school shootings and the so-called discotheque fire in Gothenburg (1998), it is deemed likely on the basis of the size of the municipality that approximately 50 additional full-time positions will need to be created for a period of at least one year, above all to manage those suffering from psychological trauma.

Based on experiences from Finnish school shootings and the so-called discotheque fire in Gothenburg (1998), it is deemed likely on the basis of the size of the municipality that approximately 50 additional full-time positions will need to be created for a period of at least one year, above all to manage those suffering from psychological trauma.

Democracy, rule of law, and human rights and freedoms

Feelings of insecurity will generally increase amongst the population nationwide. There will be a substantial spreading of rumours, especially on social media. What this will lead to is difficult to predict and depends to a great extent on how effectively the community can respond to rumours being spread. The incident may lead to increased requirements for surveillance and checks in the schools – e.g. through security guards, cameras, and metal detectors – which in turn would fundamentally change the school environment.

Probability

There has only been one school shooting in Sweden to date, in 1961, and there have been a number of threats of massacres made against schools in other cases. Incidents similar to the scenario have also occurred in the USA and Finland. A school shooting can be carried out with relatively few resources and the type of weapon that has been used in shootings in other countries is relatively easy to obtain in Sweden. Nowadays it is also possible for attackers to inspire and copy each other on the internet. The incident is therefore realistic and could happen in a Swedish school.

Uncertainty assessment

The quantitative impact assessments are uncertain. This primarily applies to the assessments of how many people would suffer from psychological issues in the short and long term, how great the associated economic impact would be, and the scope and effects of rumours being spread.

Sensitivity analysis

A scenario with multiple attackers or where it takes longer for the police to arrive at the scene would obviously lead to more serious consequences.

In the scenario, the attacker barricades himself into the building and begins shooting at the surroundings. The first police officers on the scene attempt to intervene but are met with very heavy fire. Instead of intervening, they begin securing the area while awaiting reinforcement. However, it is very rare for an attacker to barricade himself into the building and hold back the police with gunfire. A scenario in which the police are able to intervene on an immediate basis would lead to fewer fatalities or injuries.

4.3.3 Capability to be developed

A general conclusion to be drawn from this analysis is that the operational work of the police, rescue services, health and medical care personnel, and social care services would respond to the incident using their normal resources. None of these organisations will therefore be overloaded.

As described in the analysis, armed violence fortunately occurs very rarely in Swedish schools. However, this means that schools are not accustomed to managing these types of incidents. Schools often have plans and procedures in place for fires and other similar incidents, but do not have plans and procedures in place to govern their response to antagonistic incidents. In this case, for example, it might be more suitable to stay inside and await the arrival of the police instead of evacuating the school premises. The Swedish National Agency for Education, in partnership with the Swedish Civil Contingencies Agency, the National Police Board, and the Swedish Association of Local Authorities and Regions, has developed supporting materials for schools addressing how to respond to armed violence. Schools should develop procedures, on the basis of this supporting material, that govern how staff and students should respond in a situation involving armed violence.

Carrying out joint exercises at schools with stakeholders primarily from the local level in the community is also desirable.

4.4 Violent disturbances

Violent disturbances normally take the form of fires, vandalism, threats and assault, stone-throwing, and other violence against the police, security guards, rescue services, and ambulance personnel, as well as others who are perceived to be symbols of the established power structures in society. The term "social unrest" is often used to describe the underlying situation that manifests itself through incidents such as violent disturbances.

The disturbances normally take place in socially disadvantaged urban areas, although this is not always the case. Rioters are most often youths acting in small groups who stage a series of fires, stone-throwing, and so on during the course of a limited time period to elicit a reaction from society.

Possible causes for violent disturbances may be increasing urbanisation, marginalisation, and stigmatisation of suburbs, as well as the ethnicisation of communities that experience high levels of demand in areas such as housing construction, infrastructure, and employment. A widening gap between the rich and the poor, exclusion, discrimination, segregation, and cuts in public spending are also underlying factors that may cause social unrest and ultimately violent disturbances.

4.4.1 Responsibilities

The prevention of violent disturbances is largely about the make-up of society and factors such as exclusion and discrimination. Creating better living conditions is a challenge for all of society. Other initiatives relate to helping and supporting individuals, families, and groups of children and young people in socially deprived areas. Further initiatives may be community and location-based. Multiple stakeholders are involved, including in public administration. Examples of such stakeholders are the municipality and police.

The main responsibility for managing violent disturbances lies with the police. Other stakeholders may contribute to the management of the incident, including the rescue services and the health-care sector. MSB can assist in supporting co-operation (implementation of co-operation conferences), developing status reports, and co-ordinating information.

4.4.2 Scenario analysis: Violent disturbances

The analysis of this scenario was carried out in 2013 and is based on studies of literature and a review of Swedish and foreign media reporting on social unrest and violent disturbances or riot-like situations. In addition, the analysis builds on a workshop based on the current scenario conducted by MSB with representatives from the City of Gothenburg, the Royal Institute of Technology (KTH), the County Administrative Board of Gävleborg, the County Administrative Board of Stockholm, the County Administrative Board of Uppsala, the County Administrative Board of Västra Götaland, the Municipality of Nacka, the Stockholm County police, the National Police Board, Södertörn Firefighting Association (SBFF), the City of Stockholm, and the Swedish Defence Research Agency. MSB also took part in the workshop on the basis of the authority's operational assignments.

Scenario

The scenario runs from Monday 3 June until Friday 7 June. This encompasses National Day, and the end of the school year is approaching. The weather is fine.

Geographic location

The scenario is set in fictional towns and counties in Sweden.

Sequence of events

From the evening of Monday 3 June until Friday 7 June 2013, social unrest and riot-like situations flare up in several towns in four different counties in Sweden. The results of the unrest and disturbances include extensive vandalism of schools, shops, and vehicles belonging to the rescue services such as fire engines and police cars. There are also significant numbers of arson attacks on cars and leisure centres and in various sports clubs. An arson attack also takes place against a town hall, a police station, and a nursing home for the elderly. The disturbances also result in disruption to public transport. Extensive stone-throwing occurs in all towns, as well as threats and violence towards police officers, the rescue services, medical personnel, security guards, and emergency engineers. During the disturbances the incidents receive widespread attention from national and international media. Debate also arises around the various causes of the disturbances, as well as the management of the incidents.

Capability analysis

The capability to discover outbreaks of violent disturbances at an early stage is considered to a large degree to be dependent on informal and formal networks built up during preventative efforts against social unrest in municipalities.

The start of operations in the event of violent disturbances may be delayed by the fact that the municipalities are not currently obliged to have an employee on standby who can quickly raise the alarm to set in motion the affected elements of the municipal organisation.

It should be assumed that media coverage of the violent disturbances will be comprehensive and will run around the clock. It is likely to be of interest not only to national media but also to the international media. The media and individuals – not least the rioters themselves – will be filming the course of events. Pictures from the disturbances will therefore be distributed to a great extent. The impression of the disturbances and the authorities' management of them will be shaped to a great extent not only in the traditional media but also via various social media. It can currently be assumed that affected authorities are not sufficiently prepared and do not have the capability to rapidly inform the media and public of their views on the causes of the disturbances and how they are being managed. Krisinformation.se, which is managed by MSB, has a good capability to provide information about disturbances, but is completely dependent on information provided by other stakeholders such as the police and municipalities.

MSB wants to highlight the following management capabilities as being important in determining the impact of the scenario and the scope of the impact:

Management
Decisions must be taken that mean the areas affected by violent disturbances are still able to maintain the provision of key public services such as transportation. This requires, among other things, decisions on how resources should be prioritised. During this situation, MSB will prepare documentation providing a basis for decisions based on national prioritisation. Decisions about long-term and preventative measures as well as reconstruction of the affected areas must also be taken.

Co-operation
The authorities and organisations responsible need to co-operate with stakeholders such as field assistants, non-profit organisations and networks, religious communities, parents, and others to suppress the disturbances. Established platforms for more systematically working to prevent and manage disturbances are required.

The responsibility for managing disturbances is perceived as unclear when incidents cross both municipal and county borders. Networks between municipalities are often less well developed or completely absent.

Communication
It is essential that the stakeholders responsible can reach out to the public and other affected stakeholders with co-ordinated and accurate information regarding the situation and which measures are being adopted. This can create the conditions for the violent disturbances to be stopped and can prevent unnecessary anxiety in the community. It is important that public authorities make public their views on the causes of the disturbances, the course of events, and the way in which the authorities are managing the incidents.

Knowledge and skills
Experience shows that police knowledge of how to act during interventions in areas with major cultural, normative, and/or religious heterogeneity is highly significant in determining whether they are able to successfully avoid triggering disturbances through such police operations. Disturbances often occur in areas where there are low levels of confidence in the police and an intervention may thereby risk triggering further disturbances. An important question is whether local police should be given a greater mandate to act in deprived areas, as they are often more familiar with the social and cultural norms of such areas.

Resources

It is vital that the police and rescue services have the human resources to respond to a disturbance that may continue for a long period of time, i.e. these resources must have stamina and patience. If the disturbance continues around the clock for an extended period of time, the stamina and patience of the police will deteriorate significantly. Such a situation may require the redistribution of police resources on a national level.

Impact assessment

Human life and health

In the scenario eight people die and several are injured as a direct or indirect result of the unrest. In addition it is possible that someone may die due to a missed alarm or if the rescue services or ambulance crews are unable to reach them due to the disturbances.

People will, to a limited extent, suffer physical injuries due to the incidents – this may include smoke inhalation and burns. Many people will feel deeply anxious and will experience the incidents as psychologically strenuous.

One estimate is that for each fatality there will be at least ten relatives who are psychologically affected by the death. However, this will not be to the extent that they all require psychological care.

The incident will also result in some people being temporarily evacuated due to fires. The disturbances in themselves will not result in any evacuations, so this only applies to a limited number of people.

Society's functionality

Police control centres and SOS Alarm will experience heavy workloads. There is a risk that the load on the mobile network and on SOS Alarm will be so high that mobile communications will be limited and alarms may be missed. The increased workload for the police and rescue services will result in other crime prevention work being affected and taking lower priority. This will be propagated later on, as investigations taking place as a result of the scenario will continue to burden the system for some time to come.

The disturbances may complicate and delay ambulance operations as these may require police escorts in areas affected by the disturbances. This in turn may negatively affect other ambulance operations.

Local public transport may have to be suspend or divert bus routes, or alternatively post security guards on board buses to provide security and to ensure that bus drivers and passengers are not subjected to any danger. The cancellation of public transport will affect those who live and work in the area as they may e.g. have difficulties getting to and from school or work.

The scenario includes several buildings being set on fire (school, nursery, community police station, and town hall). This means that such establishments must be moved to continue operating.

Economic values and the environment

Police costs during disturbances in Stockholm county in 2013 totalled approximately SEK 10 million for increased personnel costs. The riots in England in 2011 were estimated to have cost the police in London alone approximately SEK 760 million. In addition to this are any applicable long-term costs as a result of injuries sustained by personnel. The rescue services' costs in connection with

the 2013 disturbances in Stockholm were estimated to correspond to an increase of SEK 100,000 per day. If it is assumed that the disturbances in each town in the scenario are of the same size and extent, the increase in rescue services costs could reach SEK 3 million (based on the disturbances in this scenario lasting for five days across six locations).

The municipality will incur significant expense during the clean-up and restoration process. The costs of restoring damaged buildings in the City of Stockholm following the 2013 disturbances were estimated to have cost the municipality approximately SEK 16 million.

In terms of increased costs for other stakeholders, it can be noted that during the Husby disturbances insurance companies paid out between SEK 2.5 and 7 million for cars subjected to arson attacks. Other costly issues in the long term may include increased municipal insurance excesses, and municipalities and their citizens being subject to higher insurance premiums or being uninsurable.

Democracy, rule of law, and human rights and freedoms

This scenario is likely to lead to increased insecurity amongst those who live in the affected communities and residential areas. The areas risk being stigmatised and there is also a risk that those with the financial means to do so will move away from the area. A vicious circle may be created in which those who remain in the area remain excluded, which in turn may pave the way for further disturbances.

If the affected areas are home to a high percentage of immigrants, there is an increased risk that the situation may be used by xenophobic forces.

Confidence in the authorities may be strengthened or weakened depending on how well they respond to the disturbances. If people in deprived areas perceive initiatives being implemented as short term and symbolic in nature, levels of mistrust may increase.

The spreading of rumours may occur, and an overview of the disaster will quickly be formed in the mass media and on social media that is partly based on these rumours. The rumours do not in themselves have to be harmful or maliciously intended. For example, text message groups may be initiated providing advice to stay away from certain locations where someone has heard something is going to happen. It will be important for the authorities to explain their perspective on the incidents and to link to other, reliable information. Avoiding polemicising and responding to rumours while sticking to known facts can help to build confidence.

International media coverage may negatively affect the international perception of Sweden, partly due to the incidents only being observed during the acute stage, and partly because Sweden's management of the incident will be neglected.

Probability

A number of incidents have been recorded in Sweden in recent years that suggest that the scenario is relevant and something that may happen. These include several incidents of throwing stones at police and rescue services in Malmö and Gothenburg, often in connection with the rescue services being called out to extinguish fires. Other examples include arson attacks in Malmö, Gothenburg, Stockholm, and Uppsala during 2009. In May 2013, substantial disturbances flared up in parts of Stockholm county and later spread to several other parts of the country.

The scenario that forms the basis of this analysis is, however, more serious than the incidents outlined above.

Uncertainty assessment

The impact assessment for this scenario is relatively well grounded in terms of *what kind of impact* may arise. However, there remains a high degree of uncertainty about the scope of this impact, not least in terms of the long-term economic impact for society.

Sensitivity analysis

In terms of the design of the scenario, the following factors that were not included in the analysed scenario could make the management of disturbances more difficult:

- Groups of people beginning to fight each other.
- Disturbances continuing around the clock.
- Firearms being used in the disturbances.
- Warm weather without precipitation leading to an intensification of the disturbances.
- The spread of disturbances to more locations around the country.
- The disturbances lasting for a protracted period of time.

4.4.3 Capability to be developed

As part of the analysis, the need for systematic preventative efforts instead of work characterised by a reactive "fighting fires mentality" was discussed. The causes of violent disturbances are most often manifold and complex, and there is therefore a major requirement to improve the understanding of these causes. One capability that is deficient is that there is a lack of established platforms (including networks for social risks, risk and vulnerability analyses, and established municipal and cross-border networks for managing social unrest) to facilitate systematic work to prevent and respond to disturbances.

MSB's assessment is that the following tasks are important and may affect the probability of a similar scenario occurring:

- Connect preventative measures to identifying risk factors. Common risk factors include: social, economic, and political marginalisation; economic disparities; social and territorial stigmatisation; negative belief in the future and frustration; and ethnic divisions, racism, and discrimination.
- Develop informal and formal networks through which indications can be rapidly obtained as to whether social unrest may spill over into violent disturbances.
- Publish accurate information with the intent of avoiding anxiety and uncertainty.
- Develop clear procedures to enable ambulances to quickly arrive at the relevant scenes of incidents, and ensure that police interventions do not occur in a way that may be perceived as offensive or provocative.

Responsibility for managing disturbances may be perceived as unclear when incidents cross municipal and county borders. It is therefore necessary to clarify responsibilities and co-operative relationships for such circumstances. This is a task that the Swedish Police Authority, the Swedish Civil Contingencies Agency, and the county administrative boards needs to continue working on.

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