MINISTRY OF THE INTERIOR
FINLAND

# National Risk Assessment 2015

MINISTRY OF THE INTERIOR PUBLICATION 4/2016

**Internal security**

MINISTRY
OF THE INTERIOR
FINLAND

# National Risk Assessment 2015

MINISTRY OF THE INTERIOR PUBLICATION 4/2016

**Internal security**

Ministry of the Interior
Helsinki 2016

ISSN 2341-8524
ISBN 978-952-324-060-5 (PDF)

| MINISTRY OF THE INTERIOR | DESCRIPTION<br>Date of publication<br>26 January 2016 |
|---|---|
| Authors (name, chairman and secretary of the body)<br>Working group: Taito Vainio, chairman and secretary<br>Marko Lavikkala, deputised by Jussi Hyysalo, Prime Minister's Office<br>Rita Linna, deputised by Jari Grön, Ministry of Transport and Communications<br>Juho-Antti Jantunen, deputised by Esko Pyykkönen, Ministry of Education and Culture<br>Jyri Juslén, deputised by Miliza Malmelin, Ministry of the Environment;<br>Merja Rapeli, deputised by Helena Mussalo-Rauhamaa, Ministry of Social Affairs and Health<br>Hanna Havumäki, National Emergency Supply Agency<br>Ari Lahtela, deputised by Jere Peltonen, Ministry for Foreign Affairs<br>Jukka Ristaniemi, Ministry of Employment and the Economy<br>Jaakko Weuro, Ministry of Finance<br>Hannu Tervo, Ministry of the Interior<br>Tatu Mikkola, Secretariat of the Security Committee<br>Erkko Badermann, deputised by Pekka Luoma, Bank of Finland<br>Jukka Kotilehto, deputised by Pentti Olin, Ministry of Defence<br>Riitta Ukkonen, deputised by Markku Tihilä, Ministry of Agriculture and Forestry<br>Kimmo Kohvakka, deputised by Esa-Pentti Lukkarinen, Regional State Administrative Agency for Southern Finland<br>Tapani Rossi, Centre for Economic Development, Transport and the Environment for North Ostrobothnia<br>Experts: Kristiina Säntti, Finnish Meteorological Institute<br>Eero Kytömaa, Ministry of the Interior | Type of publication<br>Publications<br><br>Commissioned by<br>Ministry of the Interior<br><br>Body appointed on<br>21 August 2014<br>SMDnro/-2015/-1520 |

Name of publication
National Risk Assessment 2015

Abstract

In accordance with Chapter II, Article 6 of the Decision of the European Parliament and of the Council on a Union Civil Protection Mechanism, Member States shall develop risk assessments at national or appropriate sub-national level and make available to the Commission a summary of the relevant elements thereof by 22 December 2015 and every three years thereafter. This Civil Protection Mechanism Decision is legislation which binds all Member States. In the EU, matters concerning the Civil Protection Mechanism (‘the Union Mechanism’) are considered by the Civil Protection Committee, which includes representatives from each Member State.

Protection under the Union Mechanism covers primarily people, but also the environment and property, including cultural heritage, against all kinds of natural and man-made disasters, both within and outside the Union. These include the consequences of acts of terrorism, technological, radiological or environmental disasters, marine pollution and acute health emergencies. In the case of the consequences of acts of terrorism or radiological disasters, the Union Mechanism covers preparedness and response actions.

On the basis of assessment of over 60 risks, 21 possible event scenarios for Finland were selected to be included in the National Risk Assessment. The scenarios were divided into two categories: wide-ranging events affecting society and serious regional events.

Wide-ranging events affecting society comprise six scenarios in the event of which any disruptions to vital functions of society or to critical infrastructure would have considerable impacts on society.

Serious regional events consist of 15 scenarios the impacts of which remain within a relatively small area. They include events that cause damage to people, property and the environment, and that may cause limited disruption of critical infrastructure or vital functions or lead to a situation where international civil protection assistance is necessary.

Possible impacts of wide-ranging events affecting society have been assessed to be as extensive as society must be prepared for them in any case. Serious regional event scenarios have been placed in a risk matrix, and their likelihood of occurrence and impacts have been assessed using a uniform criteria.

Keywords

Other information
Online version (PDF) available at www.intermin.fi

| Name of series and number of publication | | ISSN | ISBN |
|---|---|---|---|
| Ministry of the Interior publication 4/2016 | | 2341-8524 | 978-952-324-060-5 (PDF) |
| Number of pages<br>95 | Language<br>Finnish | Price | Confidentiality<br>Public |
| Distributed by | | Published by<br>Ministry of the Interior | |

CONTENTS

# 1 Introduction

***The goals and purpose of the risk assessment***

For the most part Finland's National Risk Assessment is based on the following two tenets: Firstly, having a national risk assessment makes it possible for us to distinguish unanticipated events that focus on Finland whose likelihood of occurrence and impacts can significantly jeopardise the life and health of people, result in financial and economic loss, cause environmental damage or harm society. Secondly, the National Risk Assessment shall be made pursuant to Decision No 1313/2013/EU of the European Parliament and of the Council on a Union Civil Protection Mechanism.

***EU grounds***

In accordance with Chapter II, Article 6 of the EU's Decision on a Union Civil Protection Mechanism, Member States shall develop risk assessments at national or appropriate sub-national level and make available to the Commission a summary of the relevant elements thereof by 22 December 2015 and every three years thereafter. The 'Civil Protection Mechanism' is legislation which binds all Member States. In the EU the matter is within the purview of the Civil Protection Committee which includes representatives from each Member State and which deals with matters concerning the Civil Protection Mechanism ('the Union Mechanism').

The Union Mechanism covers primarily people, but also the environment and property, including cultural heritage, against all kinds of natural and man-made disasters, both within and outside the area of the Union. This includes the consequences of acts of terrorism, disasters caused by technology and radiological accidents, environmental disasters, marine pollution and acute health emergencies. As regards disasters caused by acts of terrorism and radiological accidents, the Union Mechanism should cover civil protection preparedness measures as well as the actual response.

By utilising the Member States' national risk assessments the EU compiles a comprehensive risk assessment. This will establish situational awareness regarding the major risks that threaten the Union (extent, occurrence by region, likelihood of incidence, etc.). The EU's first 'risk overview' was published in April 2014. It is quite comprehensive and explains in detail the kinds of risks some of the Member States have put forward.

As a further step the EU is already planning the charting of its risk management capability. The premise is that an assessment of the Member States' risk management capabilities will result in a corresponding EU situational awareness of its risk management capabilities and development requirements.

***The grounds for Finland's National Risk Assessment***

The Ministry of the Interior represents Finland in the Civil Protection Committee. Therefore, the Ministry holds overall responsibility for the topic. Nevertheless, as the National Risk Assessment is closely associated with preparedness, it was prudent to conduct the national preparations for the Assessment in an intersectoral manner.

Since the Union Mechanism covers people, the environment and property against all kinds of natural and man-made disasters, both within and outside the area of the Union, the National Risk Assessment is primarily drafted from the perspective of civil protection. Furthermore, the Assessment also tries to take other vital functions into account, and identify risks that may have a wider regional or national impact. This means risks that have to be managed through resource coordination between several authorities – regionally or nationally at the very least, or even by requesting assistance from the EU. The focus is on internal risks that have immediate impact on the neighbouring area. This presentation does not address global risks.

The National Risk Assessment project was launched on 21 August 2014. The working group was led by the Ministry of the Interior, supported by the Secretariat of the Security Committee. The Committee was also responsible for issuing the guidelines for the work. The results were handled by the Cabinet Committee on European Union Affairs, and the Parliament was informed also.

Representatives in the working group included the following: Ministry of the Interior, Secretariat of the Security Committee, Prime Minister's Office, Ministry of Transport and Communications, Ministry of Education and Culture, Ministry of the Environment, Ministry of Social Affairs and Health, Ministry for Foreign Affairs, Ministry of Employment and the Economy, Ministry of Defence, Ministry of Agriculture and Forestry, Ministry of Finance, National Emergency Supply Agency, Bank of Finland and the Finnish Meteorological Institute. In addition, the Regional State Administrative Agency of Southern Finland acted on behalf of all state administrative agencies in the same vein as the Centre for Economic Development, Transport and the Environment of North Ostrobothnia represented all other Centres.

This National Risk Assessment is the first of its kind in Finland. However, administrative branches and other actors in Finland have, for a long time already, prepared their own risk assessments before the completion of this national assessment. Moreover, various assessments have been used in drafting different national strategies. For example, the Security Strategy for Society (2010) addresses threat scenarios and disruptions that impact the whole of society as well as vital functions. The Strategy also assigns strategic tasks for each ministry as regards securing the vital functions of society. Previous national documents have not compared the impacts and likelihood of different risks in the way this National Risk Assessment does[1].

In conjunction with the EU obligations, the National Risk Assessment must be updated every three years at the very least. Hence, the process of drafting the National Risk Assessment has also taken into account the process of preparing for the triennial updates.

### ***Terms and definitions***

*Risk* is comprised of two elements: the likelihood of occurrence (probability) and its impacts. The magnitude of a risk can be estimated as the product of its probability and consequences. By estimating magnitudes, risks can be placed in some sort of relative order, using the risk score, probability or impacts as attributes.

The *risk score* is the probability of an accident times its impacts. The score depends on the selected scale. The way in which probability and impacts are evaluated is shown later in this document.

The *impact assessment* takes into account the human impacts, impacts on the economy and the environment as well as on critical infrastructure and vital functions. Impact assessment is explained in more detail below.

*Probability* assessment takes into account relevant domestic statistics, when available, or foreign statistics on corresponding occurrences. If no applicable data are available, expert estimates are used.

1 The National Risk Assessment was drafted pursuant to the EU's general guidance on national risks assessments. As per the guidance, one must consider risk impact, risk probability and predicted reliability.

*Predicted reliability* is partly based on the availability of statistical data. If sufficient domestic statistics are available, predicted reliability is considered to be high. When global statistics are available but no corresponding events have occurred in Finland, predicted reliability is considered to be average. The predicted reliability which is purely based on expert estimates is considered to be low.

*A scenario* means an event at some precise geographical location or an occurrence which can take place anywhere in Finland. A scenario aims to describe the likelihood and consequences of an event.

*Critical infrastructure* stands for the systems and services of critical infrastructure mentioned in Government Resolution on Comprehensive Security (5 Dec. 2013). Under the Resolution, critical infrastructure includes:

- Energy production, transmission and distribution networks
- ICT systems, networks and services (including mass communication)
- Financial services
- Transport and logistics
- Water supply
- Construction and maintenance of infrastructure
- Waste management in special circumstances.

In addition, the Government Resolution addresses the safeguarding of critical production and services which include:

- Food supply
- Health care and basic services
- Industry
- Production and services supporting military defence

*The functions vital to Finnish society*, as per the Security Strategy for Society (16 Dec 2010), include the following:

- Management of Government affairs
- International activity
- Finland’s defence capability
- Internal security
- Functioning of the economy and infrastructure
- The population’s income security and capability to function, and
- Psychological resilience to crisis

This work takes into account events caused by natural phenomena as well as intentional and unintentional man-made events. The latter includes technological incidents.

***The methods and the process applied in drafting the risk assessment***

The process of drafting the National Risk Assessment tapped into different actors’ existing risk assessments as much as possible. In a way, the Assessment is actually an amalgamation of the different actors’ individual risk assessments.

Each branch of administration launched the project by writing ‘risk cards’ of the most critical risks affecting their branch. More than 60 risk cards were made. On the basis of the probabilities and impacts of the events registered in the cards, in all 21 event scenarios were selected that, if materialised, would cause considerable impacts on humans, the economy and the environment or on society.

Each of the selected 21 scenarios was assigned to the competent ministry. The ministry was responsible for writing its own scenario by forming a ‘writing group’. These groups were available to all organisations, and they also took advantage of the expert opinions in their respective branch of administration. The writing groups’ efforts were combined and subsequently edited into their final form by the national risk assessment working group.

The selected scenarios were further divided into two categories. The first category includes wide-rangig events affecting society, whose probability is difficult to estimate and which, on the other hand, depend on so many factors that it is extremely challenging to generate any impact assessments. The second category comprises the kinds of occurrences whose likelihood and impacts are easier to estimate but which, in any case, are regional in character. Still, they are of such a magnitude that they may warrant a request for international assistance.

While the initial phase observations mainly focused on individual risks, their subsequent handling also considered worst case, or the most probable case, scenarios. This report includes each key scenario categorised by the likelihood of its occurrence or its impacts.

EU guidelines were used in drafting the National Risk Assessment. In addition, corresponding national risk assessments and expert opinions from other countries were taken into account in the planning phase. During the preparatory process a decision was made to primarily evaluate wide-ranging events affecting society on the basis of their potential impacts. In the risk analysis of serious regional events uniform evaluation criteria were used as regards likelihood of occurrence, impact and predicted reliability so as to make different scenarios mutually comparable.

The purpose of probability estimation is to approximate the likelihood of occurrence of a given event. The more statistical information available, the easier it is to calculate probabilities. This document uses the following classification for probability estimation. The working group agreed on the probability criteria; they form a compromise of the criteria used in different sectors.

| **Numerical value** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| | | | | | |
| **Verbal** | Very low | Low | Average | High | Very high |
| | | | | | |
| **Criteria** | Less often than once every 1,000 years | Once every 500 - 1,000 years | Once every 100 – 500 years | Once every 10 – 100 years | More often than once every 10 years |

The impact assessment takes into account the immediate human, economic, environmental and societal impacts. The societal impacts are assessed by their effects on critical infrastructure and society’s vital functions. The evaluation of knock-on effects does not include any possible costs arising from warding off the event.

The impact assessment criteria were also agreed in the working group during the preparatory process. The following table presents the figures which were used in the impact assessment as regards serious regional events.

| Human impacts | I | II | III | IV | V |
|---|---|---|---|---|---|
| Dead (No) | <= 5 | 6-15 | 16-50 | 51-200 | > 200 |
| Injured (No) | <= 15 | 16-45 | 46-150 | 151-600 | > 600 |
| Evacuated (No) | <= 50 | 51-200 | 201-500 | 501-2,000 | > 2,000 |
| **Economic impacts** | | | | | |
| Material losses (MEUR) | < 1 | 1-10 | 10-100 | 100-500 | > 500 |
| Consequential loss (MEUR) | < 1 | 1-10 | 10-100 | 100-500 | > 500 |
| **Environmental impacts** | | | | | |
| Environment (sq km) | < 1 | 1-10 | 10-100 | 100-1,000 | > 1,000 |
| Duration | < wk | < mo | 1-6 mo | 6 mo -1 yr | over 1 yr |
| **Societal impacts** | | | | | |
| Critical infrastructure (No) | 0-2 | 3-4 | 5-6 | 7-8 | 9-11 |
| Duration | < d | 1 d - 6 d | wk - 2 wk | 2 wk –mo | over 1 mo |
| Vital functions (No) | 0-1 | 2-3 | 3-4 | 5-6 | 7 |
| Duration | < d | 1 d - 6 d | wk - 2 wk | 2 wk –mo | over 1 mo |

The impact assessment was made on the basis of expert opinions. The impacts on humans include the number of dead, injured and evacuated people. Economic impacts take into account material damages and consequential loss. Environmental damage takes into account the size of the polluted area and the duration of the event. Societal impacts have been taken into account through an approximation of the number of critical infrastructure factors affected by the event, its duration as well as the number of vital functions affected and the duration of the abovementioned disruption.

The risk score is calculated by estimating the probability of an occurrence in accordance with the abovementioned category, which is then multiplied by the event's average impacts. The impacts are given a score befitting their category. The score depends on the scale that has been selected. For instance, if the number of deceased is 10, the score is 2. If the number of injured is 50, the corresponding score is 3, etc. The mean score of the impacts becomes the overall impact assessment for the occurrence/event.

When it comes to serious regional events, predicted reliability is also considered by means of the criteria below. Reliability is low (numerical value 1) if the estimate is purely based on expert evaluation. When international statistics are available but no corresponding events have occurred in Finland, reliability is average (numerical value 2). If sufficient domestic statistics are available, the predicted reliability is high (numerical value 3).

| Predicted reliability | Low | Average | High |
|---|---|---|---|
| | 1 | 2 | 3 |

The traditional challenge for scenarios is that while some of them take into account the concatenation – connectedness – of events, others do not. For example, during widespread power outages, depending on the situation, many other systems also begin to fail. This being the case, the impacts cause a domino effect, causing problems in other systems as well.

As the risk assessment process advanced, the sheer difference in the magnitude of occurrences and the difficulty of estimating probability became a problem. The events included in this risk assessment differ greatly in terms of magnitude, making it inappropriate to portray them in the same risk matrix. The working group came to the conclusion that events of great magnitude which are highly probable, but whose impacts are difficult to approximate, yet are really significant should they happen, are to be analysed as a group of their own in Chapter 2 as significant events affecting society. Conversely, occurrences which are easier to assess on the basis of their probability and impacts are normally regional in scale. Therefore, they are analysed in Chapter 3 as serious regional events by means of the abovementioned criteria regarding the likelihood of occurrence and impacts.

# 2 Wide-ranging events affecting society

It is difficult to estimate the likelihood of occurrence and the impacts of risks that widely affect society. Consequently, they are not assessed on any type of numerical scale. Rather, the point of departure is that these events can take place and when they do they generate major consequences against which society needs to be prepared in any case.

The occurrence types presented in Chapter 2 are assessed on the basis of their impacts, taking into account the fact that the impact assessments are only descriptive and relative approximations as to their scope. Nevertheless, there is positive awareness over the possibility of such occurrence types and over the fact that their consequences, should they materialise, are so extensive that they deserve special attention.

## 2.1 Serious disruptions in energy supply

Having a functioning energy supply in Finland and, especially, uninterrupted access to electric power is necessary for securing society's vital functions. Finland's energy supply rests on open and well-functioning energy markets, domestic energy sources, pre-arranged continuity management capabilities in view of serious disruptions and emergency conditions as well as stockpiles of imported fuels.

***Background information***

Society is heavily dependent on electricity. Even short (less than 10 s) power cuts can pose a problem for some industrial processes. When a power cut is prolonged, in practice most functions of society are greatly disrupted or collapse altogether. Power cuts can be caused by faults in the electric grid or be the result of insufficient power generation and import capacity.

Finland is extremely dependent on energy imports because approximately two thirds of all needed energy is imported, two thirds of which come from Russia. The petroleum products used in transport, the coal used in the generation of electricity and heat, the natural gas used in industry and in the generation of electricity and heat as well as the nuclear fuel used in the generation of electricity are imported. Our dependency on fossil fuels will not markedly decrease in the coming years.

A disruption in **electric power supply**, caused by insufficient production capacity or inadequate imports, is not always easily fixed. If no reserve capacity or imports are available, the only way to respond to the situation is to limit overall consumption, possibly by means of rolling blackouts. During the peak electricity consumption period in the winter months approximately one quarter of our electricity demand is covered by imports. If the situation worsens into a power shortage, the result may be having to impose limits on electricity usage. The control systems on the transmission grid are complex, and they may face cyber threats. Yet another threat to the transmission grid is the possibility of closing non-viable power plants, which first and foremost applies to the market-based condensing power plants. In emergency and normal conditions alike, political pressure may impinge on the imports of electricity.

Faults in the **electricity transmission grid**, due to the technical features of the network, almost always result in power cuts. An additional challenge in Finland involves overhead transmission lines. Many of them go through forests where they are vulnerable to storms and prone to snow damage. Power cuts caused by faults in the transmission grid are normally geographically limited. Nonetheless, the big storms of recent years (e.g. Storm *Tapani* in December 2011) caused widespread destruction all over Finland and left over half a million electric power customers in the dark.

**The availability of fuel** plays a big role in, among other things, food and fuel transports, public transport and general logistics. Natural gas accounts for approximately 7% of heat and electricity generation and of the energy needed by industrial processes in Finland; all of it is imported from Russia.

Disruptions in **heat generation** are transitory. If drawn-out disruptions take place in wintertime, pipes may burst. A sustained shortage of household heating during a cold spell is a health threat and may even be life-threatening.

The use of **domestic fuels** relies on an extensive logistics chain. For example, the biomass chain comprises harvesting, storage (drying), transport and chipping. Problems in any link of this chain compromise the delivery of the end product, resulting in interruptions in energy production.

***Risk description***

An uninterrupted supply of electrical power is absolutely critical for the security of supply. Any serious disruption will immediately impact society's every function and jeopardise critical functions, and thereby the wellbeing of the population.

As regards the main power transfer grid the greatest risk involves two severe disruptions occurring simultaneously during peak demand. This may happen, for example, if a large nuclear power plant and electricity import connections suffer concurrent faults. Then the worst imaginable case is that the synchronised electric network will fail, causing the entire main grid to collapse. It could take days to restore power.

In the worst case power delivery scenario a bad storm passes over Finland resulting in major power outages concurrently in the areas of several electric companies. At worst, it may take several days, or even longer than a week, to repair the lines and restore power. Winter only makes the situation worse because a lot of electricity is also needed for heating.

The risk regarding imported fuels involves a stoppage in shipping, combined with delivery interruptions from Russia. Should fuel imports be disrupted for months, it would considerably begin to encumber the production of electricity and heat.

The lion's share of our internal logistics relies on road transports. Without fuel distribution and associated deliveries logistics transports would, in practice, cease until a time when fuel were again available. The availability of liquid fuels is particularly important for the domestic fuel supply. The production of domestic fuels is quite dispersed and there are several links in its logistic chain.

The risk scenario for natural gas is a several months long delivery stoppage from Russia to Finland. In order for us to buy gas from sources other than Russia we would have to build an LNG terminal or a new pipeline connecting Finland to the European natural gas market. Oil or other alternative sources of energy can replace natural gas as a fuel.

The risk for heat generation involves a disruption in a large city's heat deliveries during an extremely cold wave, possibly combined with a sustained power outage.

***Description of actions vis-à-vis the risks***

On the whole, electric power generation operates in the open Nordic power market. In unexpected situations, when electric power production and imports cannot meet the demand, consumption must be regulated. This can be achieved via, among other things, controlled rationing or rolling blackouts. The function of main grid relay protection is to avert the loss of integrated usage. As a last resort this is achieved by switching off load from the main grid. Fingrid, Finland's transmission system operator, carries out statutory tasks and, for this purpose, it has far-reaching rights. Fingrid also regularly carries out emergency exercises in view of the aforementioned scenario.

The main transmission grid is designed, built and operated so that it will tolerate and survive any individual fault (e.g. fault in a transmission line or power plant). If the main grid proves to be the cause of a disruption in power transmission, then, the situation is serious. Restoring power to normal is a time-consuming and demanding process. Depending on the situation, it can take several hours – more likely even days.

Pursuant to the Electricity Market Act, electricity transmission network operators must draw up contingency plans. Furthermore, the Act sets quite strict time limitations for transmission outages as well as compensation obligations payable to customers for power outages. Grid operators have already started a large-scale conversion of their overhead lines into underground cables in order to mitigate the impacts of storms. Normally, it is possible to repair the network in sections, which makes it possible to restore power to most customers fairly rapidly. Urban areas and other areas where cables are used in lieu of overhead lines are better protected against disruptions.

Because of our northern geographical position, our social and business structure as well as the long distances and dependence on imported fuel, it is justifiable to maintain the supply of energy security at a higher level than that prescribed by European Union obligations and the International Energy Programme.

During interruptions in fuel imports, replacement fuels will be used and, as a last resort, the obligatory and reserve stockpiles will be tapped into. Any disruptions in fuel imports that last up to a month will not result in fuel running out. The impacts to citizens are mainly rising fuel and energy prices.

When it comes to energy imports, the producers and fuel importers are obliged to maintain imported fuel stockpiles. Disruptions in natural gas and coal imports have an effect on electric power and heat production and industrial processes. As regards natural gas, compulsory stockpiling is done by storing replacement fuels, mainly light fuel oil. Coal is stockpiled as such. The industry has taken care of its preparedness obligations in the most appropriate manner, without any statutory obligation. The National Emergency Supply Agency stores imported fuels in the state's emergency stockpiles so that the country has imported fuel storages corresponding, on average, to five months of normal consumption. To guarantee the distribution of fuel, the Oil Pool and the Power Supplier's Pool have piloted the usage of standby generators at petrol stations.

Normally, there are several sources of heat connected to a district heating network. This being the case, a fault at any individual production plant will not cause any interruptions in heat delivery.

Logistic disruptions impact most of all heat generation because power plants and heating boiler stations will have to change the fuel they use. The users of domestic fuels have no replacement fuel stockpiling obligations.

***Evaluating the impacts and reliability of the scenarios***

There have been no major disruptions in electric power supply or transmission on the main grid in Finland for decades. Nonetheless, especially during peak demand, Finland is dependent on electricity imports. Disruptions in electricity production at power plants at a time when the total capacity is already in use would raise the price of electricity and, at the worst, it would result in controlled rationing. At the national level, heavy industry, the metal and paper industry in particular, is the biggest user of electricity.

Problems caused by storms and snow are quite commonplace. At the moment, a large portion of the distribution network is susceptible to storms. During the last 10 years Finland has experienced many strong storms whose impacts, here and there, have been quite extensive. Power outages, however, have not seriously threatened anyone’s life. In the aftermath of these storms the utilities have improved their preparedness in coping with storm damage.

In general, the likelihood of power outages is high and their impacts are severe. The predicted reliability, especially as regards distribution networks, is high. For the other elements, it is average.

Energy consumption, especially fossil fuel consumption, has steadily grown worldwide during recent decades. The political situation in oil producing countries significantly affects the price and availability of fossil fuels. Still, during past crises in the producing countries Finland has always managed to obtain fuel without interruption. Nevertheless, there is always some uncertainty with regard to the availability of imported fuel due to the extent (decreased availability of some fuels) and the duration of the disruption. However, the likelihood of the risk is high and its impacts are serious.

Whereas in normal conditions the probability of a drawn-out disruption in fuel supply and deliveries is low, it will always severely impact society’s functions. The most serious disruptions are associated with power outages which may hinder or altogether stop the distribution of fuel for the transport sector.

Natural gas supply from Russia to Finland has, in practice, functioned without interruption. Still, depending on one supplier and distribution channel alone increases technical and/or political risks. A stoppage lasting several months, no matter how unlikely, would, however, cause substantial repercussions in the business sector.

Heat generation is well secured and disruptions in production and/or distribution are local. There are no major uncertainty factors in their impact assessments. While Finland is yet to experience a sustained and widespread shortage of heat energy, local and short-lived disruptions, such as pipes bursting, happen every year. Especially during the heating season disruptions in heat production and/or distribution can lower inside temperatures in buildings within a few hours. The likelihood of risks in local heat generation is very high and their local impacts are regarded as being fairly serious, depending on the season.

## 2.2 Risks in the cyber domain

***Background information***

The global cyber domain encompasses a complex, worldwide information network, which includes networks of citizens, the authorities and the business community as well as critical infrastructure control and monitoring systems. From the standpoint of risks and preparedness this provides many kinds of opportunities and challenges. Network management, data warehouses, assorted technical components as well as IT competence may reside outside of Finland, and through business takeovers Finnish niche expertise may also come under foreign ownership. IT businesses operating in Finland may also be under foreign ownership and so they do not necessarily pay heed to our national special needs. Furthermore, Finnish financial and payment systems are totally dependent on viable communications with Europe.

Finland, an advanced information society, is extremely dependent on information networks and IT systems. Therefore, threats that come through the cyber domain are a major factor as regards comprehensive security. Most vital functions in society rely on data transfer, electronic databanks and IT systems. Most services in society are interlinked with electronic services.

Alongside digital dependency, many states and other actors have, associated with their own preparedness, developed cyber capabilities which have given them the skills and capabilities to interfere with, harm or take advantage of their counterpart's information systems. It is, of course, also possible to damage IT systems in the traditional fashion, i.e. physically.

Due to the interdependence of the global economy and the technological environment society's vulnerabilities have transformed. It is possible to influence the whole of society through the cyber domain, which examples both at home and abroad have substantiated in recent years. When it comes to Finland, its dependency on IT systems and, conversely, the offensive cyber capabilities of other states create the kind of potential threat to Finnish society that demands preparedness, one way or another.

Even though the transformation of the cyber domain has improved the capacity of carrying out official duties effectively and responding to different disruptions, hybrid warfare, cyber-attacks and terrorism have increased along with this transformation. Widespread cyber interference may negatively impact social order and the operations of internal security authorities in the form of increasing police, border or migration-related tasks. Alongside the development of the cyber environment, security threats have become more complex and their potential consequences more serious.

There is almost always criminal activity behind any intentional cyber incident. The volume of cybercrime has increased, and it will only keep on climbing significantly because of the growth of criminal opportunities provided by, among other things, the 'Internet of things'. Crime may increase to such extent that, with present-day resources, the police force's ability to solve cybercrime will drop significantly. This may lower the confidence citizens and companies have in the cyber domain.

Web-based platforms, utilised by criminals, have resulted in the 'industrialisation' of crime. In other words, there is talk about the 'service-based criminal industry'. The skills of cybercriminals in achieving their objectives at their target are often much better, and developing faster, than the target organisation's capacity to detect intruders.

Pursuant to the Government Decision on the Security of Supply Goals (857/2013) *The officials and the National Emergency Supply Organisation create national requirement management bases in order to ensure critical data and communication systems and the related services, as well as their* *security and continuity*. The authorities' management and control systems are part of the critical infrastructure. Should the Emergency Response Centre (ERC) information system fail, in the worst case it could even result in the loss of life.

Systems connected to IT networks can also be significant IT systems to society in other ways; they process and handle information which is vital for citizens and businesses. Banking systems or the IT systems of the health care and social welfare sector can be mentioned as examples of such systems.

Serious cybercrime often includes a strong international dimension and it poses a serious threat to society and its vital IT systems. When cybercrime targets the social welfare and health sector's IT systems, it may result in a threat to life or health. Crimes against critical financial market infrastructure can cause major damage to the economy and seriously unsettle the functioning of society. Some cybercrime may be associated with organised crime or some other serious threat.

The capability to tap into digital information will significantly redefine the position of communities and nations in the global competition, both in the traditional fields of enterprise and the export industry as well as in public administration. At the same time traditional practices, market structures and sectors will be completely transformed through the new means of utilising electronic information.

The changes in goods and services, brought about by this transformation, will become manifest in commerce and banking, in the field of entertainment and the media, among others. In the coming years the change will fundamentally hasten development in business-to-business commercial activities. This phenomenon is often referred to as the 'industrial Internet' or the 'Internet of things.'

User-oriented and dependable digital services will play a key role in the development of Finland's economy and society for the next ten years. The owners of international platforms, being the 'gatekeepers' of the digital economy, will accrue significant revenue from commercial activity that builds on their platforms; they will also acquire *de facto* influence over the dependability and reliability of different services in society.

From the standpoint of the competitiveness and productivity of Finland's national economy, and from the perspective of the new workplace and equal wellbeing, the role of Finns in the global digital service value chain will be a make-or-break question. Information security, i.e. securing the confidentiality, integrity and usability of data, is of the utmost importance to social progress and the security of people.

### 2.2.1 Utilising the cyber domain in paralysing systems vital to society

#### Risk description

A deliberate cyber-attack against the state of Finland or Finnish society, carried out by a state actor or a comparable group such as a terrorist organisation, would likely be a part of a wider crisis or conflict in Europe. It would probably be associated with the wider operation of a state actor or a comparable group, and be the culmination of months or even years of planning and development. It could be the result of a disagreement between different parties or a clash of cultures that also has knock-on effects on Finland. The goal may be to influence Finland's political decision-makers and state leadership should they not be otherwise inclined to act in accordance with the attacker's interests.

If the normal political methods of influencing do not lead to the desired result, they can be intensified through actions carried out in the cyber domain. Temporary denial of service attacks, illegal access to information systems, cyber-exploitation of information, cyber intelligence and other forms of network interference can at this stage be used as instruments of pressure. Cyber intelligence aims to determine the most cost-effective, critical targets of society that would be worth trying to influence. Cyber-attacks can also be carried out against information systems which are intentionally not connected to the Internet. If the aforementioned measures prove futile, it is possible to gradually ratchet up the actions and implement them concurrently at several levels in the cyber domain through the means described below, until the desired effect is achieved. Cyber operations implemented by states are probably but an element of other pressure. This being the case, alongside cyber operations it is probably possible to identify political, economic and – perhaps – also military pressure and influencing in the social and other media.

If the softer means do not work, cyber-attacks will target society's vital functions, decision-making and management systems, critical infrastructure included. It is possible to influence these independently, concurrently or as a continuum, one after the other. This would result in a situation where society's various IT systems, services and databanks could sustain damage to such an extent that it would severely paralyse society's functions and the capability of the state leadership.

A cyber-attack against critical financial market infrastructure can paralyse the financial and payment system, a necessary feature of society, and destabilise the financial market. When a cyber-attack targets the social welfare and health sector, energy production or industrial control systems, in the worst case it may result in material damage and the loss of life. Traditional means that cause physical destruction may accompany the aforementioned measures. Then we would arrive at a situation comparable to an armed attack, thereby justifying self-defence under the UN Charter.

***Description of actions vis-à-vis the risk***

In recent decades Finland has implemented several information and cyber security programmes and development projects, the latest ones being the Cyber Security Strategy and its national implementation programme. As a result of the guidelines of the Strategy and its implementation programme, among other things, the Cyber Security Centre has been established, the integrated situation picture has been improved and cyber expertise, awareness and cooperation among all societal actors have been improved.

The management of cyber incidents is organised and carried out in accordance with the Cyber Security Strategy, following the existing sector-specific division of duties based on statutes and pre-agreed cooperation. The competent authority will be in charge and intersectoral cooperative bodies are to support the responsible authority. At the same time, despite the disruption, the aim is to secure the maximum viability of society. Different technical solutions can mitigate the impact of the risks. For example, critical services can be segregated into their own networks, which will make it more difficult for them to be attacked.

In Finland critical infrastructure is for the most part owned by the private sector and companies tend to follow commercial logic, which creates a challenge for cyber security preparedness. Legislation does not take a uniform approach to cyber threats. Rather, legislation in this field is sector-specific. It is also a challenge to discern between an attack against an individual actor – a crime – and an act against the state. Furthermore, whereas cyber threats carried out by states are typically cross-border threats, the powers of national authorities only apply inside their sovereign borders.

### *Evaluating the impacts and reliability of the scenarios*

In addition to the intensity and scope of the cyber-attack the impacts depend on the target's information security properties and any possible countermeasures. In addition, the duration of the cyber-attack is bound up with the length of the underlying crisis or conflict. It may also be difficult to distinguish the attacker or it might be necessary to conclude from the context who he is. For this reason it is very difficult to provide an impact assessment. At worst, a cyber-attack carried out by a state would target all critical infrastructure and all vital functions. The environmental impacts, collateral damage included, may be sizeable if the attack targets a nuclear facility or water services, for example. If the worst comes to be, financial and material damage can reach hundreds of millions of euros. Loss of life is also possible.

## 2.2.2 Risks associated with cybercrime

### *Risk description*

The risks associated with cybercrime may involve terrorist crimes or cybercrime committed with the intent of profit or they may be cyber-attacks targeting critical infrastructure. On the one hand it could be supposed that threats which target critical infrastructure are focused on the *information* inside IT systems: the goal would be to alter, steal, destroy or in some manner exploit the information stored in the system, as they are the target of an unlawful act. Examples of cybercrime that target information could involve espionage or illegal data interference within the target state's important IT systems. When cybercrime targets the private sector it could entail, for example, industrial espionage, fraud or vandalism.

On the other hand, the goal of a malicious act against a critical system could be to influence the *functioning of the system per se* by feeding it incorrect control data and, hence, cause a consequence which materialises in the real world. When the act targets different control systems, the crime could be criminal mischief, traffic mischief or aggravated criminal mischief where serious danger is caused to the life or health of a great number of people.

Should the sensitive information stored in the authorities' and other actors' IT systems be entered and made public on a large scale, such as social welfare and health data or information stored on police systems, it would seriously violate the basic rights of citizens and could even jeopardise the activities of the authorities.

### *Description of actions vis-à-vis the risk*

The police identify criminal phenomena in the cyber domain and prevent, detect and investigate crimes in or against the cyber environment. The police are also tasked to identify and prevent the preparation, financing and leading of terrorist crimes and other crimes endangering social order, including associated propaganda and opinion-making as well as the dissemination of material that promotes terrorism and violence. The police must also solve any suspected crimes. The challenge for the police is to obtain adequate powers to exchange information and cooperate between the different authorities and the private sector, both at home and abroad, in order to prevent, detect and investigate crimes.

By providing the investigative authorities with sufficient powers it is possible to prevent, detect and investigate cybercrimes. Nonetheless, the capabilities of the police and the statutory prerequisites to prevent cybercrime must be further developed.

Counter-terrorism in the cyber domain is prepared for, among other things, in accordance with the National Counter-Terrorism Strategy. In other words, sufficient capabilities and powers needed to respond to terrorist cybercrime must be secured for the authorities. The authorities cooperate with each other and different actors in society receive training in identifying and preventing cyberterrorism. The police also participate in international cooperation to detect and prevent cyberterrorism. In addition, one's own cyber domain is to be protected against terrorist acts. The Finnish Communications Regulatory Authority (FICORA) – the national information security authority – supports other actors in analysing vulnerabilities in their IT and ICT systems and industrial automation systems, maintains the relevant threat and situation picture, and relays information to operators and the authorities. The financial branch has taken cybercrime risks better into consideration in business regulation and regulatory oversight. From the standpoint of preventing and minimising risks, the key points are systematic training and viable self-monitoring, both associated with the information security and safety of the users.

***Evaluating the impacts and reliability of the scenarios***

Cybercrime affects states, individual citizens and business operations alike and its economic impacts are immense. According to the threat estimate of Europol (iOcta2014), cyber-attacks committed by organised crime, hostile states or terrorist and extremist organisations pose an increasing threat to EU critical infrastructure.

### 2.2.3 Data security risks in digitalisation

***Risk description***

A disruption in digital data processing can be caused by an inadvertent or intentional act. First of all, disruptions can be caused by forces of nature (e.g. storms, floods, etc.), hardware failures (e.g. broken cables or fuses, etc.) or originate in the design, manufacture or maintenance features of IT systems (e.g. component lifespan, bad code and software vulnerabilities, etc.). Additionally, interruptions in data processing resources (power cuts, component or personnel shortages, etc.) cause disruptions.

An extremely severe, wide-ranging or sustained problem in the availability, usability, quality, interference tolerance or price of radio frequencies or communications services can degrade confidence in the production models of goods containing electronic information in different sectors. Such problems can also generate subsequent disruptions in the maintenance or security of services that depend on radio frequencies or communications services in different sectors.

In addition to interruptions yet another threat to society's vital functions is that Finnish organisations cannot sufficiently influence the quality, integrity and security of digital services and, consequently, the likelihood of disruptions.

Intelligence and violations of data protection take advantage of sophisticated and targeted malware as well as data mining. An act that violates the confidentiality of communications can also jeopardise information security in fields other than person-to-person communication ('Machine to Machine', M2). In addition to guaranteeing the 'confidentiality of correspondence' for citizens, also other legally established rights, such as business secrets, can be secured through the confidentiality of communications.

In light of the present development, serious and extensive violations of the confidentiality of communications, the protection of privacy and data protection violations in the systems used in the different sectors' service production as well as information and communication technology crimes will degrade confidence in the digital environment, key goods producers, service producers and even the authorities in the coming years. Nevertheless, the demand for individual ICT products known for their reliability and even more extensively reliable 'value chains' in the digital economy will grow. Such products include, among other things, data terminal equipment, operating systems and applications which facilitate cryptological deciphering techniques, and protection against unlawful access. Such a trend may be suitable for increasing information security and mitigating certain risks in data processing.

***Description of actions vis-à-vis the risk***

Communications policy aims at ensuring the materialisation of basic rights as best as possible by advancing the range and use of modern communications services and the efficient and interference-free use of frequencies. Statutes mandate the keeping of statistics on faults and interference in communications services and radio communications, furthermore, interferences are categorised as per their origin and harmful impacts.

Additionally, violations of the confidentiality of communications are also monitored and supervised as part of communications policy guidelines. FICORA compiles statistics on information security violations targeting communications services and IT systems on the basis of reports coming from the users and producers of ICT products. FICORA helps Finnish communities with the maintenance of their own information security by compiling and disseminating information on these violations and associated threats.

The harmful impacts of risks have been mitigated by enacting legislation which secures the viability of the communications market. Among other things, the legislation lays down the qualitative requirements for communications services, mandates the prevention and elimination of interference and guarantees the confidentiality of communications and the protection of privacy. The legislation and spearhead projects also uphold a market environment in which the service providers' competitive edge consists of customer value propositions, quality and dependability. The responsibility of IT operators to take care of the confidentiality of communications, the protection of privacy and information security was extended to apply to all media operators in a technology-neutral manner.

All sectors should improve the ways of utilising digital information in a more intelligent manner, promoting risk management and basic rights to increase productivity.

Alongside communications policy all authorities, or other public bodies, must take care of the functioning of the ICT systems used in their statutory tasks at a level which makes it possible for them to carry out their duties as best as possible in all situations. Service providers in different sectors must take care of information security risk management and comply with sector-specific quality regulations as well as intersectoral data protection legislation.

The Government will create favourable conditions for the development of a digital business environment, paying particular attention to the importance of information security in the digitalisation of the business community. At this moment, together with the business community and organisations, a national information security strategy is being drafted which will increase confidence in the Internet and digital services. The strategy will focus on guaranteeing the preconditions for export, developing the Digital Single Market for the EU and securing the protection of privacy and other basic rights. As regards the development of the Digital Single Market the goal is to advance the creation of a new industrial Internet and digital platforms in Europe which, at the same time, could improve Finland's economy and the possibilities for Finns to influence the development of their own security environment. Through the information security strategy and EU-level policies the

Government will tackle the phenomena that degrade confidence in the digital environment, such as information security violations and extensive violations of personal privacy in different networks. Moreover, at the EU level the Government is seeking to establish rules for how far another Member State can go in limiting the confidentiality of communications. The goal is to spread the responsibility of the IT operator for the protection of privacy and the confidentiality of communications to cover all media operators in a technology-neutral manner. When the EU's network and information security directive is nationally implemented, the means for improving information security in the goods production of certain key business sectors will be appraised (especially: energy, transport, the financial sector, health care, water services and certain information society service providers).

## 2.3 Serious human infectious diseases, worldwide and in our vicinity

### *Background information*

An influenza pandemic refers to a new, rapidly spreading epidemic circulating the world, caused by the influenza A virus. In a pandemic morbidity can exceed that of normal seasonal influenza. According to international estimates, 25–35% of the population can fall ill in a pandemic, where-as, the morbidity rate in a seasonal influenza is 5–10%. Moreover, the clinical description in a pandemic can be more severe than that of a normal seasonal influenza. Serious illness may also develop in otherwise healthy, young individuals and adults, rather than only among those in risk groups due to their poor health or age.

Preparedness for an influenza pandemic is explained in the National Preparedness Plan for an Influenza Pandemic[1]. During the past hundred years influenza A has caused four worldwide epidemics – pandemics: 1918–1919 so called Spanish flu, 1957–1958 Asian flu, 1968–1969 Hong Kong flu and in 2009–2010 influenza A(H1N1) Mexican flu. The latest pandemic, appearing in 2009, was caused by a new subtype of influenza A(H1N1) which contained properties normally included in influenza A strains typical of pigs, birds and humans. Apart from the aged, the population had no resistance to this virus. In addition to pandemics, the avian influenza (H5N1) from 2003–2006 was considered a pandemic threat. Cases of avian flu are constantly reported in the world, but significant human to human transmissibility is yet to be witnessed.

The severity and the impacts of influenza epidemics vary. The Spanish flu was the most serious pandemic in the past century and the 2009 pandemic was less severe than expected. In addition to the pathogenicity of the virus, other factors also affect morbidity and mortality, such as the general health situation, living conditions, standard of living and the health care facilities, which all have improved in Finland over the course of decades.

| Pandemic; onset year | Estimated deaths in the world | Estimated morbidity (sick people in Finland) | Estimated mortality (deaths in Finland) |
|---|---|---|---|
| Spanish flu 1918 | 50 million | 25% | 1.9% |
| Asian flu 1957 | 1.5 million | 30% | 0.14% |
| Hong Kong flu 1968 | 0.7 million | 25% | < 0.05% |
| Swine flu 2009 | Pending | Pending | Pending |
| Seasonal influenza | 0.25-0.5 million | 5-15% | < 0.1% (500-2,000) |

### *Risk description*

The latest large influenza pandemics have broken out at 10–40 year intervals, and the likelihood of a new pandemic outbreak is high. For society, an influenza pandemic is a significant risk: droplet infection spreads easily from person to person, the number of sick people is great and at the outbreak of the pandemic no prophylactic vaccine is immediately available. The direct impacts of a pandemic to the health care system and the rest of society are sizeable because a large number of people are taken ill and many die.

A pandemic can threaten nearly all vital functions of society, not just the health care system and its viability. Critical situations ensue when a large number of people take ill simultaneously. Vulnerable areas include, among others, the Defence Forces, internal security, energy supply, transports and food supply. A pandemic's impacts to society, production and the economy are substantial.

It is impossible to estimate the degree of risk and the severity of a pandemic beforehand. Whereas the symptoms of an influenza pandemic are normally analogous to that of a seasonal influenza, the symptoms and complications can be much more severe. It is only marginally possible to prevent the spread of influenza. Once contracted, there is no sufficient treatment because present antiviral drugs can only shorten the duration of the illness and reduce the likelihood of complications.

Outpatient services required during a pandemic wave

| Measure | Pandemic week | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Percent of population | 1 | 2 | 5 | 10 | 9 | 5 | 2 | 1 |
| Number in Finland | 52,000 | 104,000 | 260,000 | 520,000 | 468,000 | 260,000 | 104,000 | 52,000 |
| Number / 100,000 | 1,000 | 2,000 | 5,000 | 10,000 | 9,000 | 5,000 | 2,000 | 1,000 |

Estimate of patients requiring hospitalisation and deaths assuming 35% of population falls ill.

| Scenario | Population | Periods of hospitalisation | Deaths |
|---|---|---|---|
| Mild | Whole country | 11,480 | 3,450 |
| | Cases per 100,000 population | 221 | 66 |
| Average | Whole country | 27,500 | 5,650 |
| | Cases per 100,000 population | 530 | 109 |
| Severe | Whole country | 35,690 | 9,050 |
| | Cases per 100,000 population | 686 | 174 |

***Description of actions vis-à-vis the risk***

Preparedness against an influenza pandemic is described in the National Preparedness Plan which was updated following the national and international lessons learned from the 2009 outbreak of influenza (H1N1). The plan obligates the public authorities and the private sector to engage in intersectoral cooperation. Furthermore, regional and local actors are required to update their contingency plans. National guidelines on the material preparedness of the health care system were updated in 2013. A serious pandemic must be the starting point for all preparedness planning.

The goal of preparedness is to minimize the harm to the health of the population and to secure society's functions as best as possible. The most critical measure in preparedness and protecting the population is to vaccinate against the pandemic virus. Vaccinations are the most effective way to resist a pandemic as well as its spread and harmful impacts, however, the development of the vaccine can only start after the virus has been isolated. Vaccine production takes months and, therefore, it normally arrives too late to have any effect on the first wave of the influenza pandemic. Since past pandemics have broken out in several waves it is possible to protect against subsequent waves through vaccinations.

Antiviral treatment which is administered as soon as possible following the first symptoms of influenza can shorten the duration of the illness and reduce the number of complications. The National Emergency Supply Agency stockpiles antiviral drugs in view of a pandemic. Other antimicrobial drugs are needed in treating complications and they fall under obligatory stocking both in the public and private health care sector. Instructions on hygiene can help prevent infections and curtail the spread of the disease. In addition, the social welfare and health service's operational units have just recently updated their material preparedness instructions for, among other things, personal protective equipment.

The influenza and infectious diseases surveillance and monitoring networks are an integral element of preparedness. Nationwide surveillance and prevention of infectious diseases is assigned to the National Institute for Health and Welfare; it also constantly monitors the national and international situation of infectious diseases. Overall coordination of infectious diseases is within the remit of the Ministry of Social Affairs and Health.

The employment authorities, Centres for Economic Development, Transport and the Environment, Employment and Economic Development Offices together with Regional State Administrative Agencies support society's vital functions by recruiting and assigning workforce to critical sectors. Already in advance these Centres and Offices must identify the critical sectors and companies in their area whose workforce requirement must be seen to. When it comes to guaranteeing sufficient personnel for their own continuity management, Centres and Offices will focus on the essential and necessary activities. Customer service will be bolstered through telephone and web-based services.

***Evaluating the impacts and reliability of the scenario***

The likelihood of an influenza pandemic is high but its cause, onset and severity are impossible to predict. The most likely cause of a pandemic is a new zoonotic virus strain transmuted into a virus which is easily transmissible between humans. The increased movement of people and goods has markedly hastened the global spread of infections.

According to Finland's Preparedness Plan, 35% of the population may be infected during the first wave, which is estimated to last 8 weeks. As per the estimate, 11,000–36,000 people may have to be hospitalised and 3,500–9,000 may die. This kind of an influenza pandemic is more severe than the Asian Flu in 1957 or the Hong Kong Flu in 1968, but less severe than the Spanish Flu in 1918. It is not possible to predict the severity of the next pandemic and, therefore, it is also impossible to give any precise calculations beforehand.

A widespread pandemic, when a large proportion of the population is simultaneously off work, does not only pose a risk to patients and health care personnel, it also produces a risk to the health of the population and to the overall viability of society.

However, a large number of patients is a specific threat to the functioning and capacity of the health care system. Moreover, a pandemic can also generate high costs, both in terms of treatment and in loss of production, and in some cases even because of trade and travel restrictions. A pandemic often hits the youngest part of the population particularly hard because they have the weakest immunity against the virus.

Influenza pandemics have been widely studied and, hence, the predicted reliability is high.

## 2.4 A security policy related crisis which directly or indirectly affects Finland

***Background information***

The objective of the foreign and security policy is to safeguard Finland's independence and the democratic basic values of society, and to advance the security and wellbeing of its citizens. Defence policy, which also supports our foreign and security policy, steers the maintenance, development and use of the defence capacity. Together, these policies create security and prevent and repel security threats.

Finland, being a militarily non-allied country, is responsible for its own defence against military and other threats. Changes in the international situation and conflicts of interest may result in a situation where political, economic or military pressure could be used as instruments against Finland. Should the situation escalate, the use of armed force against Finland cannot be excluded. Regional crises in past years, which have also included the element of the use of force, have arisen suddenly and after a quite short period of escalation. The means of influencing can encompass complex combinations of instruments in the use of force. At the same time when the forms of using force keep expanding the boundaries between them are becoming increasingly blurred. It is more and more difficult to discern the difference between war and pressure, or state and non-state action. Information warfare, including cyber-attacks, and the use of special forces is now an integral element in the actors' range of instruments.

In recent years Russia has tried to bolster its status, especially as a regional, but, also as a global, power. This has resulted in tension between NATO and Russia, which, in turn, has increased the significance of the Baltic Sea. Following the crisis in Ukraine NATO is increasingly shifting its focus back to developing the Alliance's collective defence.

***Risk description***

Political, economic or military pressure aims to intentionally sway the decision-making and action of the state so as to achieve goals to which the state being pressured would not otherwise submit. The pressure can target political decision-makers or public opinion, it may include interference in the activities of the authorities, enterprise, services or financial and payment systems as well as obstructing and hindering, and military violations of territorial integrity or troop concentrations near our borders.

Different instruments can be used for political, economic and military pressure, and it may appear in various forms. Pressure can be dispensed through the media or in international fora. It may consist of individual actions or it can gradually increase and, ultimately, occur at several levels concurrently. Various information operations, such as network interference or psychological operation, are nowadays progressively more included in all of the aforementioned forms of pressure. Pressure can also be an element in 'hybrid warfare' which combines military and non-military means.

If the hostile party has not achieved his goals, the use of military force can follow political, economic and military pressure. In this kind of situation the use of force would probably begin with a surprise attack against preassigned targets. The vulnerability of an advanced information society creates favourable conditions for a successful attack.

If the adversary does not reach his goals with limited military operations, he may commit more troops to carry out large-scale operations, using different combinations from his range of instruments. A sizeable portion of society's resources must be allocated to supporting the military defence, which makes a significant impact on society's functions.

The boundaries between the abovementioned operations are by no means clear, and the adversary is free to combine and schedule them at will. In any case the operations, akin to pressure, aim at forcing the state leadership to take the desired decisions which the adversary could not achieve through pressure alone. Still, before the situation escalates into a military threat there is probably a period of pressure, as described above, which aims at achieving certain goals without having to resort to military force. Then again, the boundaries between war and pressure can be extremely fleeting, and different forms of pressure and warfare can be interchangeable.

***Description of actions vis-à-vis the risk***

The goal of Finland's defence policy is to sustain a national defence capability suitably tailored to our operating environment and resources; its most important goal is to prevent Finland from becoming the target of pressure or an attack. The capabilities of the Defence Forces and the Border Guard establish a deterrent which makes it possible to manage the border situation, safeguard territorial integrity and to prevent and repel a military attack.

The military operating environment and the assessment done on it are the key factors in planning the development and implementation of military defence. The transformation of the operating environment and Finland's geostrategic position on the borderline between a military alliance and a great power must be taken into consideration when the defence system is being planned. It is possible for us to quite precisely monitor the military capacities and their development in our neighbouring states. In contrast, it is not as easy to assess the political will associated with the use of armed force creating the threat. Whilst political will can change rapidly, improving one's military capacity is a slow process. The events in Ukraine demonstrated that the political will to exercise military power exists in Europe, too.

Finland has networked with other states and international actors, which supports the development and maintenance of the defence system. A wholly independent defence in today's networked and interdependent world is no longer a realistic or cost-effective option. When military readiness is raised the Defence Forces' capabilities are supplemented by material obtained from society as well as domestic and foreign companies. Furthermore, the Defence Forces maintain the capacity to receive military assistance which, among other things, may come in the form of material, troops or situation picture exchanges.

***Evaluating the impacts and reliability of the scenarios***

Different combinations from the available range of instruments have been used in recent European military conflicts. The probability of the hybrid threat against Finland is low – average. This manifests itself in, among other things, increasing information operations and cyber operations ('trolling').

The situation in Ukraine, which escalated in 2014, serves as an example of a crisis in which different means are combined. The EU has actively proposed different options for the peaceful settlement of the crisis. In 2014 Russia annexed Crimea in violation of international law and, therefore, the EU imposed sanctions on Russia. In conjunction with the events in Ukraine Finland has emphasised EU unity, the importance of continued negotiations and the full implementation of the Minsk Protocol.

In accordance with the scenario, during a crisis and conflict anti-EU factions could retaliate against Finland, an EU Member State, with different economic and political measures – or, alternatively, they could offer unexpected proposals for cooperation.

In the scenario, when Finland remains in the united EU front, the other party ups the ante and carries out different actions against Finland. The status of groups of people living in Finland is critically reviewed; various problems are put forward and demands are made for them to be fixed. Any possible actions of the authorities on immigrants living or arriving in Finland, and conflicts between them and the local population are sensationally aired in the media. Anti-EU NGOs operating in Finland are supported, and their opinions are followed and broadcast in the news.

In the scenario, the IT networks of Finnish companies and authorities are subjected to denial of service attacks. Finnish energy companies discover malware in their systems. Illegal immigration increases and border traffic is disrupted.

Military exercises increase in the vicinity of Finland and new troops are positioned near our borders. Sea and air traffic in and over the Gulf of Finland increases markedly. In the narrow international corridor of the Gulf of Finland vessels and aircraft disregard national borders which results in violations of territorial integrity. The exercises may involve sea denial in certain areas, which disrupts foreign trade. Exercises include operations which, from the standpoint of Finland, can be construed as threatening.

If the pressure does not result in the desired outcome, limited or large-scale military operations may follow. Limited operations ensure achieving the desired goals with minimum resources. The adversary may want to deny third party access close to his area, or establish a military buffer zone to protect his strategic targets. Limited operations may also include the occupation of certain areas and air/sea denial. Alongside the armed forces, limited operations may target society's vital functions such as telecommunication networks, energy and electricity distribution networks, transport hubs, logistics centres or foreign trade connections. In addition, they may include psychological operations and other information operations as part of the use of force.

If the adversary does not reach his goals even with limited military operations, he may commit more troops to carry out large-scale operations, using different combinations from his range of instruments. In this case he tries to destroy Finland's defence capability in order to achieve the desired end result. In order to repel large-scale operations a sizeable portion of society's resources must be allocated to supporting the military defence, which makes a significant impact on society's functions.

***Scenario 1: Political, military and economic pressure***

The situation in Ukraine, which escalated in early 2014, serves as an example of a crisis in which political, economic and military pressure as well as special forces and, especially, information operations are used.

In addition to the scope of the adversary's actions the impacts also depend on national preparedness, countermeasures and society's crisis resilience. The impacts on society can be very serious. During the pressure period it is likely that the impacts on people and the environment remain marginal or even non-existent. If the pressure includes economic features such as restrictions on exports and imports, interference or obstructing, even preventing, shipping in the Baltic Sea, the indirect economic impact may rise to tens or even hundreds of millions of euros. The pressure will inevitably affect all vital functions to a degree but, depending on its character, its impact may remain negligible, particularly if it does not last long. The same applies to critical infrastructure targets. Yet, ICT systems and networks may well be the target of interference and the situation may pose a challenge to psychological crisis resilience. Moreover, the military defence will have to remain at a higher readiness compared to normal.

The predicted reliability and the impact assessment level are sufficiently high.

***Scenario 2: Use of military force***

While Finland faces no military threat at this moment, the situation may change, and a military threat cannot be entirely excluded. Although Finland is well aware of the military capabilities and their development in its neighbourhood, reaction time remains very short. The reason why the threat is so difficult to assess is that it necessarily entails an estimate of the political will to use armed force (capacity x will = threat).

In addition to the scope of the adversary's actions the impacts also depend on national countermeasures and society's crisis resilience, including psychological crisis tolerance. The use of military force may also manifest itself in a limited strategic strike; this being the case it does not always involve large-scale military operations. The impacts on society, however, may be extremely serious or even catastrophic. In the worst possible case the impacts on people, the environment and the economy are disastrous. Likewise, the use of military force impacts all critical infrastructure and all of society's vital functions. The after-effects may linger on for months or even years, if the time for recovery and restoration is taken into the equation.

Both the predicted reliability and the reliability of the impact assessment are at an unsatisfactory level because it is impossible to precisely anticipate the effect and scope of the use of military force.

## 2.5 A severe nuclear accident in Finland or in our vicinity

***Background information***

Despite the nuclear safety measures used to mitigate the safety risks in nuclear power plants, the possibility of a severe nuclear accident cannot be totally excluded.

A large amount of radioactive substances could be released into the environment in a severe accident at a nuclear facility if the reactor containment building failed to function as planned. The ensuing radiation hazard requires a rapid implementation of protective measures for the protection of the public, foodstuffs and production facilities. Furthermore, it may prove necessary to implement appropriate measures on e.g. agriculture and forestry, the food industry and other industry, water supply, traffic (road, air, sea and rail), recreational activities, trade, transports, import and export, the decontamination of buildings and the environment as well as waste management and disposal. A variety of measures may become necessary even hundreds of kilometres away from the accident facility.

***Risk description***

Finland has two nuclear power plants with four units: two units in Loviisa NPP and two in Olkiluoto NPP. In addition, a new unit, Olkiluoto 3, is presently under construction and another unit is planned to be built at Pyhäjoki. The nuclear facilities in Finland's neighbourhood include two power plants in Russia and one in Sweden. The Russian plants are the Leningrad nuclear power plant in Sosnovy Bor and the Kola nuclear power plant in the Kola Peninsula. The Swedish power plant near Finland is located in Forsmark. A radiation hazard could be caused either by an accident in a Finnish nuclear power plant or in a nearby foreign facility. The management of such a situation demands measures from all branches and levels of administration as well as the private sector. The effects from the situation can be serious, requiring major efforts from society to prevent and limit the consequent damage. The situation may also require long-term actions, such as decontamination of inhabited environment, resumption of normal living conditions, and ascertainition of the safety of foodstuffs and drinking water. Moreover, management of the resulting radioactive waste can take years and years; a recovery can take decades.

Any severe nuclear accident, no matter where it occurs, has direct or indirect harmful effects on other countries:

<u>The Chernobyl accident in April 1986</u> spread radioactive substances in a very large area (Fig 1). Almost all of Finland also received mild radioactive fallout. The growing season was just beginning when the accident occured; because of this and instructions given to agricultural sector, such as to continue indoor feeding of livestock, Finland did not suffer any notable foodstuff contamination. Restrictions were imposed on natural products for a long time; even as late as 2014 some fresh water fish and wild mushrooms contained such high concentrations of cesium that their sales to the public were forbidden.

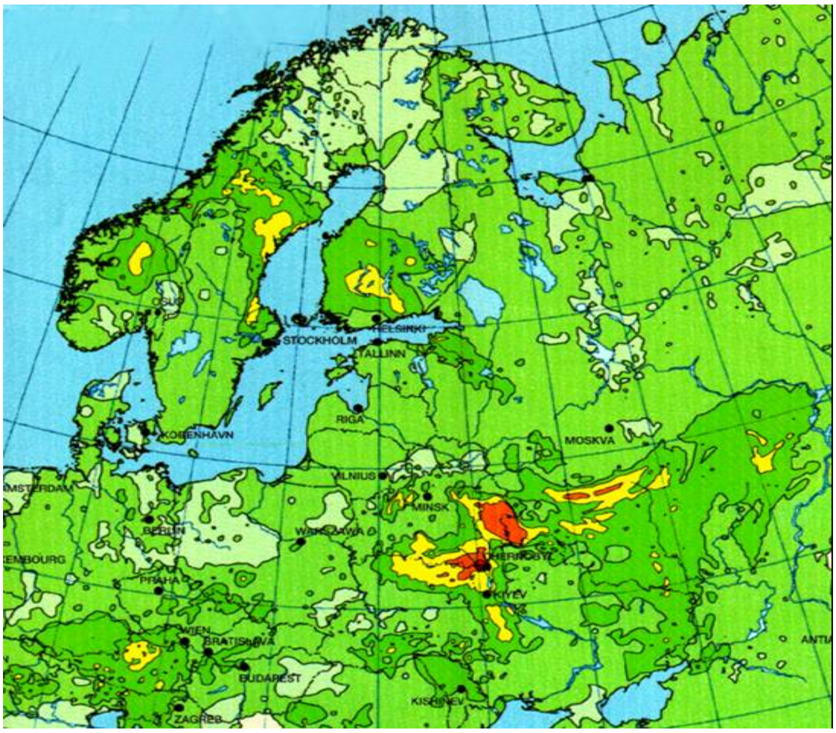


*Figure 1. Chernobyl fallout in Europe in the spring of 1986. Outside Ukraine, Belarus and Russia the worst fallout was experienced in Finland, Sweden and Norway. There is still a 30 km exclusion zone around Chernobyl owing to environmental contamination.*

<u>The Fukushima nuclear power plant accident</u> (2011) directly affected mainly Japan (Fig 2). Japanese authorities had to evacuate 170,000 people and launch massive foodstuff monitoring and environmental decontamination programmes. The volume of radioactive waste currently totals 30 million cubic metres. Japan is presently building large interim storages where the waste will be stored for 30 years. Final disposal will commence only after the period of interim storage.

Even though some affected areas have been decontaminated from radioactive substances, no large-scale return of people to these areas has begun. Some evacuated areas will be closed for a long period of time. Harmful psychological effects among affected population have also been common.

During the accident, other countries, Finland included, had to take decisions on, for example, the protection of their citizens located in Japan, continuation of traffic to and from Japan, and guaranteeing the radiation safety of imports from Japan.

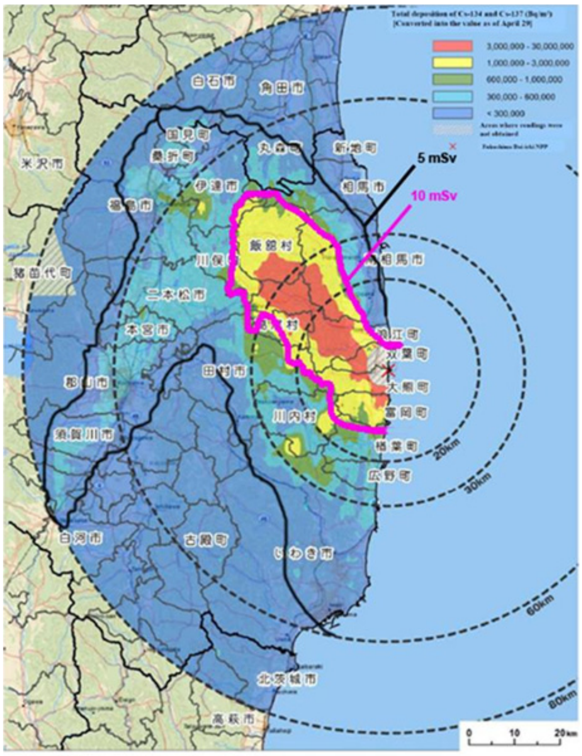


*Figure 2. Area contaminated by the accident in Fukushima. In all 170,000 people were evacuated from inside the area delimited by the pink line.*

***Description of actions vis-à-vis the risk***

*Preventing accidents*

The use of nuclear energy is subject to a licence (Nuclear Energy Act, 990/1987). The construction of a nuclear facility requires a government resolution and Parliament approval. The Government grants the licences for constructing and operating nuclear facilities. A prerequisite for a licence is a safety assessment by the Radiation and Nuclear Safety Authority. Operation of the nuclear facility may not begin on the basis of a licence granted before the Radiation and Nuclear Safety Authority has ascertained that the nuclear facility meets the safety requirements and that the security and emergency arrangements are sufficient. The requirements for the design and operation of a nuclear power plant are laid down in Government Decrees (e.g. Government Decree on the Safety of Nuclear Power Plants 717/2013) and in the Radiation and Nuclear Safety Authority's Regulatory Guides on nuclear safety.

The safety goal of nuclear facilities is to prevent the escalation from disturbances to accident. The greatest accident risk at a nuclear facility is caused by heat generated by the decay of radioactive fission products in a nuclear reactor even after reactor shutdown (termination of the chain reaction), which requires fuel rod cooling and residual heat removal. If the cooling is lost, the fuel rods overheat and are damaged.

It must be possible to achieve reactor shutdown and to ensure cooling of the reactor and isolation of radioactive substances inside the containment building during an incident. Several redundant and separate alternative safety systems are in place for incident management and accident prevention. The design of a nuclear power plant and its important safety systems must comply with the following principles:

- Redundancy: Important safety functions are ensured by several alternative subsystems. Safety is ensured if two out of four or one out of three redundant subsystems keep functioning. For example, there are several auxiliary diesel generators and emergency cooling pumps.
- Physical separation: Parallel subsystems are designed in a way that simultaneous damage of those systems due to same reson is unlikely. Parallel subsystems can be located in separate spaces or, if located in the same space, at a distance from one another. For example, auxiliary diesel generators are located in separate rooms.
- Functional separation: The safety function is implemented through several differently operating systems. For example, there are several disparate sources of electrical power, such as external sources and auxiliary diesel generators. Reactor shutdown can be achieved via control rods or injecting dissolved boron into the reactor core.

Yet another key safety principle at nuclear facilities is to provide several layers of isolation between radioactive substances and the environment in case of an accident. The goal is to contain radioactive substances inside the facility or limit releases to environment to a minimum even in a severe accident.

- The first barrier between the environment and the nuclear fuel is the cladding enclosing the fuel. In normal use the radioactive substances remain inside the intact cladding.
- The second barrier is the reactor pressure vessel and the primary circuit, which, should the fuel cladding be damaged, will contain the radioactive substances that are released into the reactor coolant water.
- The third barrier is the high-pressure-proof, gas-tight reactor containment. Its purpose is to contain the radioactive substances should both the cladding and the primary circuit fail, preventing the release of radioactive substances into the environment.
- The fourth barrier is a reactor building surrounding the actual reactor containment.

<u>The Loviisa nuclear power plant</u> has two 500 MW VVER-type reactor units. A VVER is a Soviet-designed pressurised water reactor type. The two units in Loviisa were completed in 1977 and 1980. They are licenced to operate until 2027 (Lo1) and 2030 (Lo2). The safety system at Loviisa incorporates, for the most part, quadruple redundancy. The reactor and the primary circuit are inside a steel 'ice condenser containment' cylinder. Several modifications were completed on the units in the 1990s in case of an accident involving core meltdown. Moreover, following the Fukushima accident, the facility launched projects that have improved the preparations for loss of sea water cooling, high sea levels and pumping water into fuel pools during exceptional situations. Even in the light of the lessons learned in the wake of Fukushima, Loviisa's severe accident management procedures were determined as satisfactory.

<u>The Olkiluoto 1 and Olkiluoto 2</u> boiling water reactors were completed in 1979 and 1982. Since their completion their output has been increased and their current net outputs are 880 MW and 860 MW, respectively. The power plant units were supplied by the Swedish AB Asea Atom (nowadays Westinghouse Electric Sweden AB). The units are licenced to operate until 2018. Their safety system incorporates quadruple redundancy. The reactor is surrounded by a reinforced concrete containment building. Several modifications were completed on the power plant units in the early 1990s in case of an accident involving core meltdown. Moreover, following the Fukushima accident, the facility launched projects which have improved the preparations for loss of sea water cooling, loss of auxiliary power and pumping water into fuel pools during exceptional situations. Even in the light of the lessons learned in the wake of Fukushima, Olkiluoto's severe accident management procedures were determined as satisfactory.

The Olkiluoto 3 unit is based on the French-German EPR (European Pressurised water Reactor) concept. The net output of the plant, presently under construction, will be approximately 1 600 MW. The reactor and its cooling system are surrounded by a reinforced concrete containment building. When compared to the original EPR concept, Olkiluoto 3 incorporates considerable safety improvements. In addition, following Fukushima, certain additional improvements were launched, but, in general the unit was considered to be extremely well protected against external threats even in light of the lessons from Fukushima accident, withsevere accidents already taken into consideration in the basic design.

*Neighbouring area cooperation*

The main objective of nuclear safety cooperation between Radiation and Nuclear Safety Authority and Russia is to support measures preventing a nuclear accident at power plants near Finland's eastern border. The cooperation projects focus especially on the safety of Leningrad and Kola nuclear power plants as well as supporting the safety efforts of Rostechnadzor – Russia's Federal Environmental, Industrial and Nuclear Supervision Service. The cooperation includes exchanging information and lessons learned, and provision of equipment. Preparedness issues are also included in the cooperation and the representatives of both countries typically participate in each other's emergency exercises as observers. The present scope of nuclear safety cooperation with Russia is at the level of EUR 1.5 million per year. Together with the Nordic countries and international organisations, Finland delivers equipment to the power plants located in Leningrad Oblast and in Kola.

*Preparedness*

Finland is prepared for accidents at nuclear power plants. Notification of nuclear hazards is ensured from domestic power plants as well as from those outside Finland's borders. Finland is party to international early notification conventions, and Finland also has bilateral agreements with its neighbours, which obligate prompt notification of any potential nuclear incidents to the parties in the agreement.

The general requirements for preparedness for nuclear and radiological emergencies are laid down by acts and decrees. In addition, for emergencies in domestic nuclear plants, Government Decrees and Radiation and Nuclear Safety Authority's Regulatory Guides on nuclear safety also apply. The preparedness arrangements also cover training and exercises. The Ministry of the Interior Decree (774/2011) sets forth the requirements on the information to be provided to the public in advance of and during a situation involving a radiation hazard. The Government Resolution on Security Strategy advises that vital functions are secured by the efficient and comprehensive exploitation of society's resources.

There are guides and instructions to assist inemergency planning as well as correctly-timed and suitably tailored response. They cover the early phase and the intermediate phase of a nuclear or radiological emergency. The most important are the guides on rprotection strategy in a nuclear or radiological emergency, including the protective measures and the associated criteria, as well as the guide published by the Ministry of the Interior, describing the responsibilities of different actors, their tasks, cooperation, exchange of information, and communications.

Training and exercises are conducted on a regular basis. Both domestic nuclear power plants organise large-scale emergency exercises every three years. All key actors at the central, regional and local government levels participate in these exercises. In addition, both power plants organise annual, smaller-scale, exercises. Joint exercises are organised with the neighbouring countries, and their representatives are also invited to participate in the exercises that take place in Finland.

### *Evaluating the impacts and reliability of the scenario*

The theoretical probability of a severe accident at a domestic nuclear power plant is very small (once every 10,000 or 100,000 years). Even though the safety arrangements at Russian power plants have improved over the course of time, their risk for a severe accident is estimated to exceed that of nuclear power plants in Finland. Severe reactor accidents have happened at an interval of 20–30 years: Windscale, UK (1951), Three Mile Island, USA (1979), Chernobyl, nowadays Ukraine (1986) and Fukushima, Japan (2011).

An accident at a nuclear power plant in Finland or in the vicinity can cause such a radiation hazard that all governmental levels and branches must be harnessed to manage it. Its impacts can be extensive, in which case a massive response from the whole society is needed in order to recover from the damage. Post-accident management can also require sustained efforts, and recovery can take decades. A nuclear or radiological emergency has critical impacts on the living conditions of humans and their environment, severe psychological and societal impacts as well as large economic impacts.

The immediate health impacts of nuclear power plant accidents have been limited. In Chernobyl, 31 out of the 170 or so rescue workers that developed acute radiation sickness died. The accident resulted in a strong increase in thyroid cancer in children; approximately 2,000 children subsequently developed that form of cancer. The increase in cancer cases was primarily caused by radioactive iodine in milk. In Japan, the radiation *per se* did not cause any negative health effects. Nevertheless, approximately 60 out of 700 patiens perished in the evacuations of nearby hospitals and elderly care facilities, or soon thereafter. This happened mostly because there were no plans for such evacuations and appropriate transportation arrangements were not in place for seriously ill patients. Moreover, the evacuation transit lasted over 10 hours.

The economic impact of a severe accident at a nuclear power plant is sizeable. Evacuations and decontamination efforts have proved expensive. The costs for the Japanese nuclear power company TEPCO amount to 2,000 Euros per month for each relocated person during the entire evacuation period. During the post-accident management and recovery phase, which lasts for years, even decades, it is possible to effectively reduce the population's exposure to ionising radiation through different health care and environmental hygiene measures. These measures are focused on the primary production of foodstuffs, monitoring food and water distribution and on decontaminating people, children in particular. For example, in Japan it cost nearly EUR 300 million to decontaminate approximately 22,000 homes in a city of 60,000 inhabitants 30 km away from Fukushima. Despite that, it is very problematic to start reusing the decontaminated area.

Radiation, because it is odourless, has no taste and is invisible, still evokes fears and emotions. While the capability of a fearful and anxious population to absorb complex information is quite limited, its need for facts is voracious.

The theoretical probability of a severe accident at a nuclear power plant is extremely small. Following Fukushima, the stress tests carried out in EU countries, which analysed, among other things, the impacts of extreme natural phenomena on nuclear safety, uncovered needs for improvement at different plants, the ones in Finland included. Each country which uses nuclear power developed an action plan for implementing the required measures. Ensuring nuclear safety demands continuous efforts as well as cooperation between national and international actors.

## 2.6 A 100-year risk scenario for a solar storm

### *Background information*

Finland is the world's coldest country, being nearly entirely within the auroral zone[2], so an extremely intense solar storm period occurring during a cold spell generates the strongest cold weather related effects in the world. Depending on their duration and intensity solar storms, or geomagnetic storms, can impact electric power distribution, telecommunications, food and water services and infrastructure.

Geomagnetic storms can be roughly divided into three categories: radio blackout, solar radiation and geomagnetic storms. They can occur independently or concurrently. The most profound impacts in Finland and elsewhere are felt when the three types occur simultaneously.

The Halloween Solar Storm of October-November 2003 is one example of a solar storm periods during which the three types of solar storms appeared simultaneously. While the total duration of the storm period was over two weeks, the most intense disturbances and damage occurred within two days. Among other things, the Halloween storms are known to be the cause of an extensive power outage in *Malmö*, Sweden, destroyed satellites (e.g. ADEOS-2 which cost EUR 540 million[3] to build), forced aircraft to be re-routed, and caused positioning errors, 'ghost calls' and material damage to households.

### *Risk description*

The impacts of solar storms are global and their cascading effects can be substantial. Large solar storms are sporadic and only rough statistical methods exist for forecasting them. Solar storms are observed during every season and each phase of the 11-year solar cycle period (solar minima and maxima as well as the ascending and declining phases). Even average-intensity events that occur once a year or more frequently can interfere with radiocommunications, satellite communications and positioning. Contact with the Galaxy 15 communications satellite was lost for a week during the 2010 solar minimum. The estimated cost of the lost communications was approximately EUR 77 million.

During the extreme solar storm period several solar storms occur successively and, at times, the three different types appear concurrently. Solar storms cause interruptions in satellite communications, problems in navigation, interference in radiocommunications and faults in electric power distribution for days or even weeks. A simultaneously occurring extreme cold weather would worsen the situation significantly. For their part, problems associated with food and water supply peak in the summertime.

### *Description of actions vis-à-vis the risk*

The Finnish Meteorological Institute's (FMI) Earth Observation unit together with the Weather and Safety Centre and the Arctic Research unit are responsible for 24/7 monitoring, forecasting and warning of space weather phenomena that can cause danger or harm. Experts are constantly monitoring solar activity and space weather, and analysing the scale and probability of the risk. During a solar storm hazard situational information and warnings are relayed through established channels, i.e. via the LUOVA and KRIVAT systems.

---

[2] Rings of aurora emission centred around the magnetic poles.

[3] Service Assessment, Intense Space Weather Storms October 19 – November 07, 2003, U.S. Department of Commerce, NOAA National Weather Service, US, 2004

Many projects of the FMI study solar storms and their impacts. The ReSoLVE[4] Centre of Excellence studies long-term solar variability and its effects, the SOLE project studies solar storms and their frequency, and the SAFIR[5] project's 'Extreme weather and nuclear power plants' (EXWE) -subprojects study the impact of solar storms on nuclear safety. The FMI independently carries out geomagnetic and other space weather observations which are then utilised in solar activity monitoring and space weather forecasting.

***Evaluating the impacts and reliability of the scenario***

Solar storm-induced disturbances are observed everywhere in Finland. Minor solar disturbances occur in Polar Regions almost non-stop. Major disturbances causing widespread impacts occur approximately 1–2 times in the 11-year solar cycle. It is estimated that solar storms which have the capacity to impact the entire country and society's different sectors occur once in a century. Typically, the impacts of solar storms last from a couple of hours to a few days. Strongest solar disturbances generate several successive solar storms whose total duration is estimated to last several weeks.

***Probability***

Large solar storms impacting the Earth occur 1–2 times during the 11-year solar cycle. It is estimated that extreme solar storm periods, during which all three solar storm types appear simultaneously, occur a few times in a century. Observations and research data from Finland and elsewhere were used as the grounds for assessing the probabilities.

***Risk impact***

Human impacts:

Causes indirect impacts on thousands of people because of shortages in electricity, heat, clean water and telecommunications (e.g. coldness, hospitals and receiving assistance), among other things. Slowly cumulative biological impacts on Finns occur in air travel at high latitudes.

Economic impacts:

Interference in satellite communications, or the complete destruction of a satellite, causes significant direct harm to the users of satellite communications and indirect harm to functions that depend on uninterrupted electric power (energy supply, water services and telecommunications). The economic and other impacts compound if the disruption becomes prolonged.

Environmental impacts:

Solar storms have no direct environmental impacts. Indirect impacts can be caused, for example, because of infrastructure breaking due to insufficient heating; this may result in, among other things, the release of harmful agents into nature.

Societal impacts:

Solar storms generate indirect impacts on energy supply, synchronised data transfer systems, communication systems, aviation and navigation as well as transport logistics and households.

---

[4] Additional information http://www.spaceclimate.fi/resolve/
[5] http://safir2014.vtt.fi/

***Predicted reliability***

Satellite-based observation data on solar activity has only been available for a couple of decades. Observations from the surface of the Earth or random observations have been made since the 18th century. The volume of modern observational data is continually increasing, and historical observations are being digitised. Long-term data series' scientific and impact analyses will improve prediction reliability.

# 3 Serious regional events

## 3.1 Extensive rapid flooding in or around urban areas

***Background information***

Floods that occur in Finland can generally be divided into over-flowing bodies of water (watercourses), storm surge and stormwater flooding caused by downpours in municipalities. Flooded bodies of water are usually the result of continual rain or large amounts of snow meltwater, but, due to ice jams and frazil ice jams, river water levels can also rise rapidly. Stormwater floods are the result of heavy rain or meltwater in built-up areas. Stormwater floods start quickly, are short-lived and relatively localised, but because of their suddenness and potential to cause damage to urban areas their effects can be significant. Storm surge can cause rapid but widespread flooding in low-lying regions in coastal areas. Floods can also be the results of dam or other water structure failures or be due to blockage in waterway routes.

For example, floods can cause adverse consequences to human health or safety, the environment, infrastructure, economic activity and cultural heritage. Floods endangering life and limb are very rare in Finland. Instead, the damage is mostly directed at buildings, infrastructure and personal property. The damage to infrastructure and buildings can indirectly impact human health via water and mould damage and polluted drinking water. An exceptionally large flood – an 'extreme flood' – can have quite extensive direct and indirect impacts on the viability of infrastructure and the livelihood of the population. At its worst, a flood can also generate a widespread environmental disaster which may result in permanent consequences to the environment and living conditions.

In monetary terms flood damage, on average, amounts to less than one million euros per year. However, annual variation is great. So far the greatest flood damage in the 2000s was caused by heavy rainfall. The stormwater flood in Pori on 16 August 2007 caused up to EUR 20 million worth of damage to buildings, personal belongings and vehicles. As regards water body floods, damage in the Kittilä area in 2005 amounted to EUR 4.7 million. The total for spring and autumnal flooding in 2012 was approximately EUR 10 million, and in 2013 the combined damage caused by spring flooding in the whole of Finland was approximately EUR 5 million.

Flood risk management means all measures which aim to assess and reduce flood risks, and prevent and mitigate the actions required by flooding. Flood risk management is improved by assessing the flood risks in waterways, coastal areas and stormwater flood risks; by charting significant flood risk areas and preparing flood risk management plans for them; by taking the risks into account in land use planning; and by implementing sufficient flood protection measures at critical locations. In order to improve operational flood protection, hydrological monitoring and forecasting as well as flood warning services and cooperation arrangements are maintained.

***Risk description***

A flood causing major damage can be the result of exceptionally high water levels in a watercourse or the sea in urban or other coastal areas where flooding can endanger human health or safety or cause the long-time interruption of indispensable services, such as water supply, energy supply, health care, or telecommunications and transport. Great damage can also be caused by an exceptionally heavy downpour when it falls in an area where stormwater can cause corresponding damage.

When the significance of a flood risk is assessed, the probability of a flood as well as its potential overall adverse consequences must be taken into account. The consequences depend on the danger caused by the flood (coverage, water depth, flow rate, duration, rate of rise in water level, point in time and contamination) and the vulnerability of the flooded area (susceptibility, scope of damage).

***Description of actions vis-à-vis the risk***

The overall objective of flood risk management is to reduce flood risks, prevent and mitigate losses caused by flooding and advance flood preparedness. Flood risk management means all measures which aim to assess and reduce flood risks and prevent and mitigate the actions required by flooding. Flood hazard and flood risk maps have been drawn up for 21 significant flood risk areas and for about 70 other areas. Flood maps can be used to estimate the scope of damage caused by the rise in water level in water bodies and the sea, and to plan appropriate measures to prevent and mitigate the ensuing damage. Flood risk management plans will be drawn up for the potential significant flood risk areas; the plans will incorporate the goals for flood risk management for the given area and the measures required to meet the goals in an order of priority. Corresponding flood risk management will also be done in the other areas, as required.

It is possible to mitigate flood risks with quite disparate measures, such as land use planning, flood protection structures, regulation, improving civil protection and flood awareness, river ice sawing, and improving public and private preparedness. In order to improve operational flood protection, hydrological monitoring and forecasting as well as flood warning services and cooperation arrangements between the authorities and other actors will be maintained. It is virtually impossible to make any impact on the occurrence and extent of sea water rise and urban stormwater flooding. Climate change can make them more commonplace which makes it all the more necessary to invest in storm surge and stormwater flood preparedness and mitigation. Water services can reduce flood consequences, for example, through risk assessment and by maintaining disinfection readiness.

***Evaluating the likelihood of occurrence, impacts and reliability of the scenario***

***Likelihood of occurrence***

Floods can be categorised by their frequency into fairly rare, rare and extremely rare floods. When expressed in terms of average recurrence, the corresponding categories are: once every 50–100 years, once every 100–250 years and less frequently than once every 250 years. Judging by the flood protection levels which have been in use, and the present flood risk management goals, it can be estimated that, in general, substantial damage ensues from rare and extremely rare floods, i.e. such floods that occur less frequently than once every 100 years.

On the basis of the national risk assessment categorisation the probability of a flood that causes substantial damage is average; it is 3 in numerical value.

| Probability | Very low | Low | Average | High | Very high |
|---|---|---|---|---|---|
| | | | 3 | | |

### *Risk impact*

There are 21 significant watercourse and sea level flood risk areas where flooding, from a general perspective, is estimated will generate significant adverse effects. Approximately 75,000 people live in the affected areas. In addition to the significant flood risk areas, approximately 70 riparian areas have been identified as other flood risk areas. Flood risk management must also be implemented in these, as required. Furthermore, any urban area can experience flood damage following an exceptionally heavy downpour.

Flood damage can be direct or indirect. Whereas immediate damage results from the direct impact of floodwater on human health and safety, property or the environment, indirect damage is the result of interrupted economic activity or traffic disorder. Floods threatening human health and safety are very rare in Finland. The consequences of a once-in-a-century flood are usually directed at low-lying buildings and transport corridors. However, an exceptionally large flood – 'extreme flood' – can have quite extensive direct and indirect impacts on buildings and the viability of infrastructure as well as the livelihood of the population. At its worst, a flood can also generate a widespread environmental disaster which may result in permanent consequences on the environment and living conditions.

| **Human impacts** | I | II | III | IV | V |
|---|---|---|---|---|---|
| Dead (No) | <= 5 | | | | |
| Injured (No) | <= 15 | | | | |
| Evacuated (No) | | | 201-500 | | |
| **Economic impacts** | | | | | |
| Material losses (MEUR) | | | 10-100 | | |
| Consequential loss (MEUR) | | 1-10 | | | |
| **Environmental impacts** | | | | | |
| Environment (sq km) | | | 10-100 | | |
| Duration | | < mo | | | |
| **Societal impacts** | | | | | |
| Critical infrastructure (No) | | | | 7-8 | |
| Duration | | 1 d - 6 d | | | |
| Vital functions (No) | | | 3-4 | | |
| Duration | | 1 d - 6 d | | | |

### *Predicted reliability*

Flood risk management has already been implemented for a long time and the new flood risk legislation that entered into force in 2010 launched nationwide flood risk management planning which, among other things, comprehensively and on uniform grounds estimates Finland's flood risks. With the help of flood risk management planning, rainwater, water body and sea level information, documented flood observations and new Geographic Information System (GIS) data, the occurrence of floods and their potential adverse consequences are extremely well known.

On the basis of the national risk assessment categorisation the predicted reliability of flood risk assessment is high; it is 3 in numerical value.

| Predicted reliability | Low | Average | High |
|---|---|---|---|
| | | | 3 |

***Overall estimate***

| Risk assessment | Probability | Impact assessment | Risk score |
|---|---|---|---|
| | 3 | 2.36 | **7.1** |

## 3.2 A serious chemical accident or explosion at a plant handling dangerous substances

***Background information***

This subchapter studies the likelihood of a major chemical accident or explosion in or near a population centre from the standpoint of handling and storage of dangerous chemicals.

There are hundreds of chemicals and explosives establishments in Finland where there is the potential for a major chemical accident or explosion. Some of these industrial establishments fall under the 'Seveso Directive' as installations having major-accident potential. Pursuant to the Directive, Member States shall identify major-accident hazards and take all necessary measures to prevent major accidents caused by dangerous substances and limit their consequences to human health and the environment.

Major accidents occur extremely rarely at chemicals and explosives establishments. Still, each year several minor accidents happen in which people are injured, or even die, or in which a leakage of a dangerous substance causes an environmental hazard.

One of the most devastating peacetime accidents in Finland happened in 1976 in a cartridge factory explosion in Lapua. It resulted in 40 fatalities and 60 employees being injured. Almost all of the employees who died were females, most of them married. While the exact cause of the accident was never ascertained, strong suspicions focused on it being a gunpowder dust explosion caused by a spark in an ammunition loading machine on the cartridge production line.

The most recent risk for a major accident occurred in 2013 at an explosives factory in Laukaa. The hazard was caused by an overheated and smoking container which contained bulk-emulsion explosive waste. At the time of the incident there were 40 tonnes of explosives in storage. The event resulted in 2,000 people being evacuated from around the factory.

***Risk description***

A risk can either concern one establishment which manufactures, handles or stores chemicals and explosives or a cluster of several such establishments. Regulations take into account the potential for a cascading accident where an accident at one production facility sets off another accident at the adjacent installation. These installations have a particular obligation to exchange hazard and risk information.

An occurrence such as a major emission, fire, explosion or other phenomenon resulting from uncontrolled developments in the course of the operation of an establishment producing, handling or storing dangerous chemicals or explosives may lead to serious immediate or delayed danger to human health, the environment or property. The chain of events may involve one or more dangerous substances.

A chemical accident that results in a chemical release which is carried to a population centre necessitates, at the very least, the requirement to stay indoors or the need for an evacuation. Seveso installations are often situated close to inhabited areas. The worst case scenario can happen in a situation where the knock-on effects of an accident at one production plant set off another one at an adjacent establishment, i.e. a ‘domino effect’. Among other things, the chain of events can stem from heat, explosive pressure or ejecta.

***Description of actions vis-à-vis the risk***

The Chemicals Act lays down provisions on the safety arrangements for establishments handling dangerous chemicals. An establishment must inform the people living nearby and in the potential accident zone of the risks and threats associated with the operation, and prepare an emergency plan for the area inside the perimeter of the installation. Furthermore, the rescue authorities must prepare an external emergency plan which details the actions that can minimise the consequences of an accident in the most efficient manner.

Drafting the external plan is the responsibility of the local rescue department. Associated with this the emergency services, together with the operator of the installation, must regularly organise major accident exercises so as to ascertain that the emergency plan functions as intended. External emergency plans are part of the risk management carried out by rescue departments. Targets that warrant external emergency plans are also locations that carry significant risk and also appear in the rescue services’ risk analyses. In turn, the rescue department’s risk analysis is the platform for a Service Level Decision which determines the regional availability and level of emergency and rescue services and available resources.

The Finnish Institute of Occupational Health, together with the National Institute for Health and Welfare, operates a 24/7 on-call service which provides a situational risk assessment to the authorities during dangerous chemical accidents.

***Evaluating the likelihood of occurrence, impacts and reliability of the scenario***

***Likelihood of occurrence***

There are hundreds of chemicals and explosives establishments in Finland where there is a potential for a major chemical accident or explosion. The Chemicals Act lays down provisions on the safety arrangements for establishments handling dangerous chemicals. Despite the fact that accidents or serious incidents have occurred during the past 10 years, the probability of a risk is still low. Proper action can reduce the likelihood, and the repercussions, of an accident at installations that have a major-accident potential.

| Probability | Very low | Low | Average | High | Very high |
|---|---|---|---|---|---|
| | | 2 | | | |

***Risk impact***

Human impacts:

Normally the impacts of an accident remain inside the perimeter of the installation. However, during major accidents evacuations may be required.

Economic impacts:

Whereas the impact is mostly directed at an individual installation or actor, it can resonate wider among similar actors. It is possible to control and limit the impact.

Environmental impacts:

The scope of the environmental impact depends on the chemical in question. Some chemicals may have serious consequences. Whereas the impact is most often local, the damage can be sustained.

Societal impacts:

The societal impacts are negligible.

| **Human impacts** | **I** | **II** | **III** | **IV** | **V** |
|---|---|---|---|---|---|
| Dead (No) | | | 16-50 | | |
| Injured (No) | | | 46-150 | | |
| Evacuated (No) | | | | 501-2000 | |
| **Economic impacts** | | | | | |
| Material losses (MEUR) | | | 10-100 | | |
| Consequential loss (MEUR) | | | 10-100 | | |
| **Environmental impacts** | | | | | |
| Environment (sq km) | <1 | | | | |
| Duration | | < mo | | | |
| **Societal impacts** | | | | | |
| Critical infrastructure (No) | 0-2 | | | | |
| Duration | | 1 d- 6 d | | | |
| Vital functions (No) | 0-1 | | | | |
| Duration | < d | | | | |

***Predicted reliability***

The predicted reliability is high, as is the assessment of probability. Major accidents and incidents have occurred in Finland during the past 10 years.

| **Predicted reliability** | **Low** | **Average** | **High** |
|---|---|---|---|
| | | | 3 |

***Overall estimate***

| **Risk assessment** | **Probability** | **Impact assessment** | **Risk score** |
|---|---|---|---|
| | 2 | 2.18 | **4.36** |

## 3.3 A major maritime accident

***Background information***

The growing volume of sea traffic in the Baltic Sea, increased shipping of dangerous substances, larger and larger ships, intersecting sea lanes, demanding navigation conditions and hard winters in the northern Baltic Sea increase the risk of a major accident at sea. Moreover, significantly increased tension in the area would also reflect on shipping and increase maritime safety threats.

Since 2006 the volume of shipping at Baltic Sea ports has increased at an annual rate of about 6%. Approximately 2,000 merchant ships continuously sail the Baltic Sea. Particular growth has been witnessed in the ports of Russia, Latvia and Lithuania. Most of the cargo handled in the ports of the Baltic Sea is liquid bulk cargo which includes crude oil and petroleum products and different types of chemicals. Shipping is strongly centred on Russian ports, especially Primorsk and Ust-Luga where Russia has invested heavily in recent years.

It is estimated that by 2030 the volume of shipping will have grown approximately 30% from the level of 2010. Much of the growth will likely come from container shipping focused on the eastern part of the Baltic Sea. However, oil transports are estimated to decrease a bit due to the growing popularity of replacement fuels such as LNG and biofuels. Many uncertainty factors make it difficult to estimate the volume of shipping; the particularly difficult questions relate to questions associated with alternative fuels. In addition, rapid fluctuations in global economic policies impact the assessment. The price of oil, international crises and terrorism can rapidly alter the picture.

***Risk description***

*Maritime accidents*

Approximately 180 maritime accidents occur in the Baltic Sea each year, about 70 of which are in the northern part of the Baltic Sea. On average, annually, three of these are major maritime accidents. Most accidents happen to dry bulk carriers and ro-ro passenger ships. Dry bulk carriers are also most often involved in major shipping accidents. Fires and groundings are the most typical types of accidents that have serious consequences. As the volume of traffic and ship size keeps growing, the risk of a major accident also grows. Particularly risky areas to merchant shipping are narrow fairways in the archipelago as well as intersecting sea lanes. The difficult sea ice conditions also make navigation more difficult.

The objective of the BRISK-project, completed from 2009–2012, was to evaluate environmental risks caused by shipping accidents in the entire area of the Baltic Sea, and the possibilities for reducing such risks. According to the report approximately 44 groundings and 4 collisions happen to ships of 300 gross register tonnage (GRT) and above per year. The number of oil spills in the region is considerably smaller: only 1 to 2 per year. Four oil spills involving ships of 30 GRT and above have happened in Finland since 1990. The greatest threats for oil spills involve collisions between vessels. Likewise, when large ships' fuel tanks rupture during groundings, this can also generate a major environmental hazard, especially in sensitive archipelago regions.

The Chembaltic project, completed in 2013, forecasts that a chemical tanker will be involved in a collision once every 77 years in the Gulf of Finland. The estimated probability of a chemical leak in a collision is approximately 40%. The probability of grounding is higher than that of a collision, once every 4–16 years, but only 6% of groundings would result in a chemical leak.

Judging by its accident history, maritime safety in the northern Baltic Sea is fairly good compared to the other regions. Since the shipwreck of m/s Estonia, there have been no accidents causing multiple fatalities or serious environmental damage. Nonetheless, the present level of safety must be fostered every day.

*Accidents involving human rescue*

The most serious types of accidents at sea are capsizing or foundering caused by grounding or a collision, as well as an uncontrollable fire raging aboard a ship.

The worst case scenario is an evacuation of a passenger ship in difficult conditions, or a collision between a large passenger ship and an oil tanker or a container vessel transporting chemicals. On the other hand, the relatively short distances in the Baltic Sea and the good civil protection readiness in the different countries make it easier to rapidly launch appropriate rescue efforts.

Machine and propulsion malfunctions, the most often occurring faults, are estimated to be the greatest threats to ro-ro passenger ships. When this happens the ship often loses its ability to manoeuvre which may result in serious consequences.

Judging by previous major accidents it can be estimated that threats relate to groundings (m/s Sally Albatross), founderings caused by hull damage (m/s Estonia) and fires (m/s Scandinavian Star, m/s Norman Atlantic, m/v Lisco Gloria). Human factors also often play an important role in accidents (m/s Costa Concordia).

*Oil and chemical accidents*

The intense growth in oil and chemical transports has increased the chance of serious environmental accidents. At present, 25 per cent of the vessels in the Baltic Sea are either oil or chemical tankers.

A chemical tanker accident carries low probability but large repercussions. In addition, spill recovery at sea is always extremely demanding and requires special training and equipment. Oil and chemical spill recovery in ice conditions is an extremely difficult and slow process.

Information about the risks created by chemicals to the marine environment is the key factor when it comes to accident preparedness. The large variety of packaged chemicals being handled at ports, and their great volume, make them a threat which is difficult to control.

The most significant environmental threat in Finnish territorial seas comes from oil tanker traffic heading to the refineries in Porvoo and Naantali, and chemical tanker traffic to Tahkoluoto chemical port in Pori. Whereas chemical cargo is shipped to the ports in the Gulf of Bothnia (Tornio, Kemi and Oulu), chemical transhipments are handled at the ports of Hamina and Kotka.

***Description of actions vis-à-vis the risk***

The authorities' actions can be divided into measures that either prevent accidents or mitigate their consequences, and into those that improve maritime search and rescue.

The most important preventive or mitigative measures are the functions that maintain and develop ship safety and the safety of navigation. Matters associated with ship safety are based on the regulations or recommendations of the International Maritime Organization (IMO) or EU legislation which are implemented nationally. The regulations concern, among other things, ship construction and equipment, the manning and carriage of cargoes as well as shipowners' safety management systems. Their implementation, among other things, is monitored in flag state and port state controls.

Hydrographic surveying, channel and fairway planning and upkeep, vessel traffic service and traffic control as well as pilotage and icebreaker services are important factors in the safety of navigation. When the need arises to prevent an environmental disaster or to evacuate large numbers of people, the national preparedness to designate an appropriate place of refuge for a vessel becomes highlighted.

The operating models in maritime Search and Rescue (SAR) are based on international conventions and bilateral agreements with neighbouring countries. Readiness is a major factor in post-accident response. If the situation continues, the neighbouring countries can also provide assistance within a few hours.

Maritime SAR readiness in Finland is based on close coordination under the Maritime Search and Rescue Act, supplemented through different guides, such as the Maritime Search and Rescue Manual, and joint contingency plans, such as the Mass Rescue Operation Plan (MoMeVa). In addition, maritime SAR authorities and ship managers are actively developing their mutual cooperation, joint planning and uniform operating models in view of accidents (e.g. the Vessel Triage project). The authorities and ships regularly organise different kinds of exercises, their topics ranging from individual practices to major accidents. The authorities are also developing national and international cooperation through different projects (e.g. BSMIR and MIRG projects[6]).

Cooperation and communication between the Finnish authorities can be considered to be extremely good. The national level maritime accident preparedness plans are at a relatively satisfactory level. More work needs to be done on developing shared information services and systems, and on integrated situational awareness.

***Evaluating the likelihood of occurrence, impacts and reliability of the scenario***

In the worst case scenario there are two vessels involved, at least one of which is a large passenger ship. The other ship could be a bulk carrier transporting dangerous cargo or another large passenger ship. The total number of people to be evacuated is 6,000, 10% of whom (= 600 persons) are multi-trauma patients who need hospitalisation. Their most serious injuries and wounds include burns, injuries to the lungs and airways from smoke inhalation or different kinds of contusions and fractures. Furthermore, a large number of the rescued passengers suffer from hypothermia.

During the cold season the able-bodied evacuees must be transferred to warm spaces. If the situation continues for several hours, everyone on life rafts and lifeboats will become a hypothermia patient needing medical treatment. Difficult weather and ice conditions can significantly hamper the rescue effort, or aggravate an otherwise less critical accident into a critical one.

A place of refuge can be designated to a vessel in distress so as to facilitate the rescue operation and to prevent additional damages. The main interests to be taken into consideration in selecting the place of refuge are the protection of human life and the environment. Maritime SAR emphasises the rescue of humans. The victims of the accident are primarily rescued with the ship's own rescue equipment. The maritime rescue authorities will provide requested assistance to the master and the crew of a ship in the evacuation as well as in SAR activities concerning those who have fallen into the sea. If the situation entails a clear danger to the marine environment, it falls within the purview of the environmental authorities.

Ships need additional resources for damage and fire control, first aid and triage as well as preparing the patients for transport. The rescue services' MIRG teams and maritime SAR personnel will be used in support of the crew in the rescue operation.

All available national and international surface vessels and aircraft will be assigned to the rescue operation. The severity of the situation calls for international coordination already in the early phase

[6] Baltic Sea Maritime Incident Response Survey (BSMIR), Maritime Incident Response Group (MIRG)

to guarantee sufficient resources. The efficient operation of aircraft is coordinated from the Maritime Rescue Coordination Centre, as per the Baltic ACO model. Because of potentially long distances the helicopters cannot necessarily take the patients directly to hospital. Rather, they are airlifted to the closest suitable evacuation sites from where they will continue by ambulance. Able-bodied persons and patients with minor injuries will be evacuated to other ships at the accident site and to the closest warm evacuation centres. Helicopter refuelling and basing arrangements must be ascertained from the onset of the rescue operation.

The goal is to prevent the foundering of a ship in distress through joint cooperation between the maritime SAR service, environmental authorities, maritime authorities and commercial salvage companies. When it comes to a fire on board, the rescue authorities will provide assistance insofar as necessary to save human life or protect the environment. In order to prevent major material or environmental damage the rescue authorities can also participate in salvaging material. When human life or environmental protection aspects are not concerned, the actual salvage operation will be carried out by a commercial salvor following the signing of a salvage contract with the shipowner and the insurance company. The authorities will supervise the salvage effort, lest it jeopardise the environment or the safety of other seafarers.

### *Probability*

The probability of a major accident at sea is fairly low but it is entirely possible. Judging by statistics major accidents are extremely rare (less often than once every 10 years). However, when it comes to major accidents, relying on statistics alone is not a prudent course. Ship construction, human factors, the shipowner’s safety culture, technology and the operating environment markedly affect the risk of a major accident.

| Probability | Very low | Low | Average | High | Very high |
|---|---|---|---|---|---|
| | | | 3 | | |

### *Risk impact*

A major maritime accident carries significant impacts. It also has transborder characteristics (international cooperation, several nationalities among the passengers and the crew)

Human impacts:

The direct impacts of a major accident on a passenger ship involve thousands of people, and the indirect ones from hundreds to tens of thousands of people.

A chemical tanker accident happening on the open sea can expose one or more members of the crew to the effects. An accident close to the coastline can extend the impacts all the way to the shore.

Oil and chemical spills can require an evacuation from the polluted shoreline, and cause a long-term ban on the use of the littoral area.

Economic impacts:

Oil and chemical spills have wide-ranging impacts on commercial activities and consumers. The accident can damage the fishing industry (professional fishing, fish farming and fishery processing), harm the recreational use of the polluted coastal area and other commercial activities. An oil spill can impede or terminate the functioning of industries and power plants that use seawater in cooling.

Environmental impacts:

Because of vessels' structural protection (e.g. double hulls) accidents do not necessarily cause a direct impact on the environment. Oil and chemical spills can, however, cause multifarious consequences to the ecosystem, which are difficult to detect and recover. The ecological impacts are both immediate and direct as well as sustained and indirect. The ecological impacts of an oil spill on the marine population adapted to the Baltic Sea environment can be quite serious and even permanent. Because of the poor condition of the Baltic Sea even a slight increase in pollution can be disastrous.

Societal impacts:

Failed rescue efforts or public relations disasters cause negative reactions towards the authorities. Accidents tend to degrade the passengers' sense of safety. The negative impacts of an oil or chemical spill on the use of the polluted shoreline and people's enjoyment can be significant.

| **Human impacts** | **I** | **II** | **III** | **IV** | **V** |
|---|---|---|---|---|---|
| Dead (No) | | | | | > 200 |
| Injured (No) | | | | | > 600 |
| Evacuated (No) | | | | | > 2,000 |
| **Economic impacts** | | | | | |
| Material losses (MEUR) | | | | | > 500 |
| Consequential loss (MEUR) | < 1 | | | | |
| **Environmental impacts** | | | | | |
| Environment (sq km) | | | | 100-1,000 | |
| Duration | | | | | over 1 yr |
| **Societal impacts** | | | | | |
| Critical infrastructure (No) | | | 5-6 | | |
| Duration | | | wk - 2 wk | | |
| Vital functions (No) | | 2-3 | | | |
| Duration | | | wk - 2 wk | | |

***Predicted reliability***

The risk assessment is based on the common risk assessment of all actors participating in maritime SAR. It was prepared as part of the joint Mass Rescue Operation Plan (MoMeVa). In addition, the evaluation taps into several Finnish and foreign risk assessments.

For the authorities, major accidents are the most challenging topic as regards preventative measures. Constant efforts are needed to minimise the risks of major accidents, which must be taken into consideration when the shipowners' safety management systems are audited. All-inclusive solutions for the system's stress tolerance and preparedness for demanding situations must be developed together with organisations and crews. Crisis exercises, delegating authority to the operational level for the time of crisis, and existing plans for increasing resources flexibly in crisis situations can be useful topics for improvement.

| **Predicted reliability** | **Low** | **Averagw** | **High** |
|---|---|---|---|
| | | | 3 |

***Overall estimate***

| Risk assessment | Probability | Impact assessment | Risk score |
|---|---|---|---|
| | 3 | 3.73 | **11.2** |

## 3.4 A major aviation accident

***Background information***

Annually, approximately 400,000 commercial flight operations occur in Finland. These flights transport almost 20,000,000 passengers. The annual rate of growth, globally, is approximately 5%; in Europe it is approximately 2%.

Due to the international character of aviation the biggest risk for a Finnish traveller to experience an aviation accident is somewhere abroad; even then the risk is low in proportion to the number of flights.

The strategy of Helsinki-Vantaa airport is to be a hub between Asia and Europe. In addition, Finnair's strategy of investing in Far East traffic has resulted in scores of wide-body aircraft, seating approximately 300 passengers, operating at Helsinki-Vantaa. This is on top of the number of operations carried out in smaller aircraft types.

During the past 30 years two fatal accidents have occurred in Finnish commercial aviation, in Finland:

- Copterline 2005; off the city of Tallinn, 14 dead
- Wasawings 1988; 6 dead, 2 seriously injured

During the observation period there were four occurrences categorised as accidents. None of the events resulted in injuries to persons, and they were interpreted as individual occurrences. Due to the small number of events it made no sense to create an indicator which was proportioned to them.

Occurrences categorised as serious incidents happen once a month, on average, in commercial air transport. The following illustration shows that the increasing trend in the early phase of the timeline is mostly the result of improved categorisation and the decreasing trend at the end of the timeline the result of favourable safety development. It is safe to say that, judging by the number of serious incidents, the safety of Finnish commercial aviation is good.

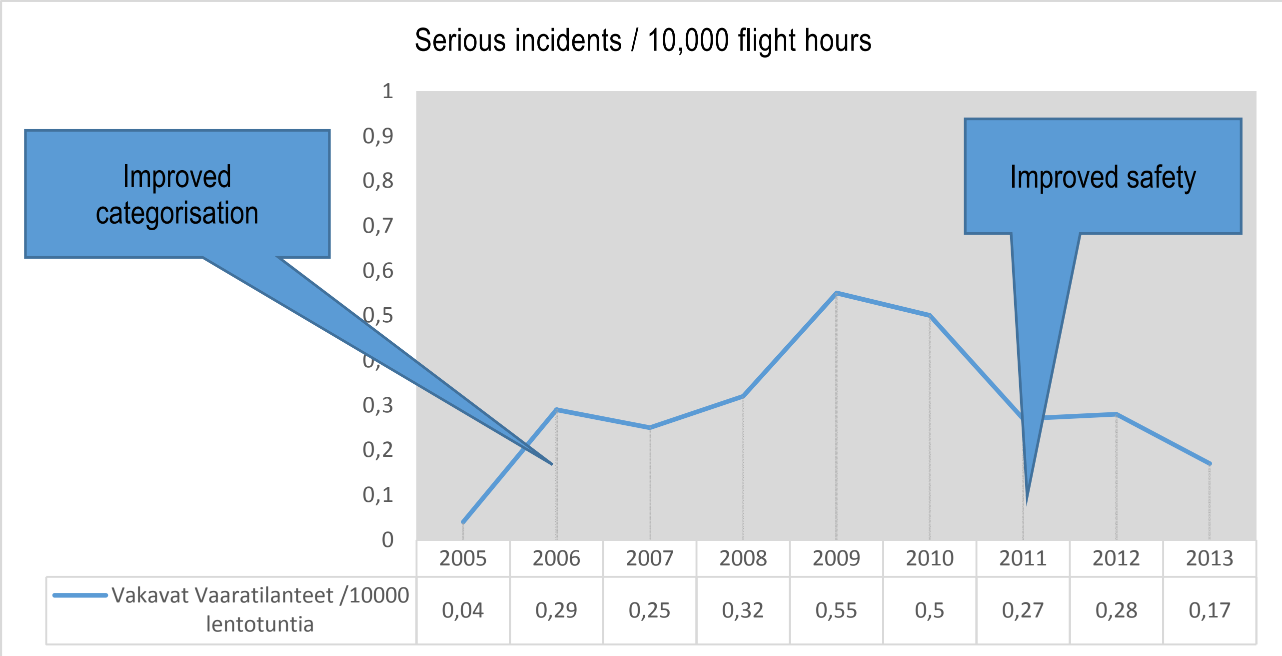


Figure 3. Serious incidents per 10,000 flight hours.

**The trend in the frequency of serious incidents**

The following six main accident occurrence categories have been identified in aviation, which are also followed as indicators in Finland (RI, RE, MAC, GCOL, CFIT, LOC-I):

**Runway incursion (RI)**

- Runway incursion means *any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and takeoff of aircraft*.

**Runway excursion (RE)**

- Runway excursion means *a veer off or overrun off the runway surface*.

**Mid-air collision (MAC)**

- Mid-air collision refers to *all collisions between aircraft while both aircraft are airborne*.

**Ground collision (GCOL)**

- Ground collision means *a collision while taxiing to or from a runway in use. Includes collisions with an aircraft, person, animal, ground vehicle, obstacle, building, structure, etc.*

**Controlled flight into or towards terrain (CFIT)**

- Controlled flight into or towards terrain means *an inflight collision or near collision with terrain, water, or obstacle without indication of loss of control*.

**Loss of control in flight (LOC-I)**

- Loss of control in flight means *loss of aircraft control while, or deviation from intended flightpath, in flight*.

On the basis of analyses compiled on global accident data, **runway safety** is the area where the biggest improvements are needed. However, it must be noted that the end result of accidents in the different categories varies widely; injuries to persons in CFIT and LOC-I class accidents are more or less unescapable. According to statistics only 5% of LOC-I accidents for the period from 2009–2013 resulted in no fatalities.

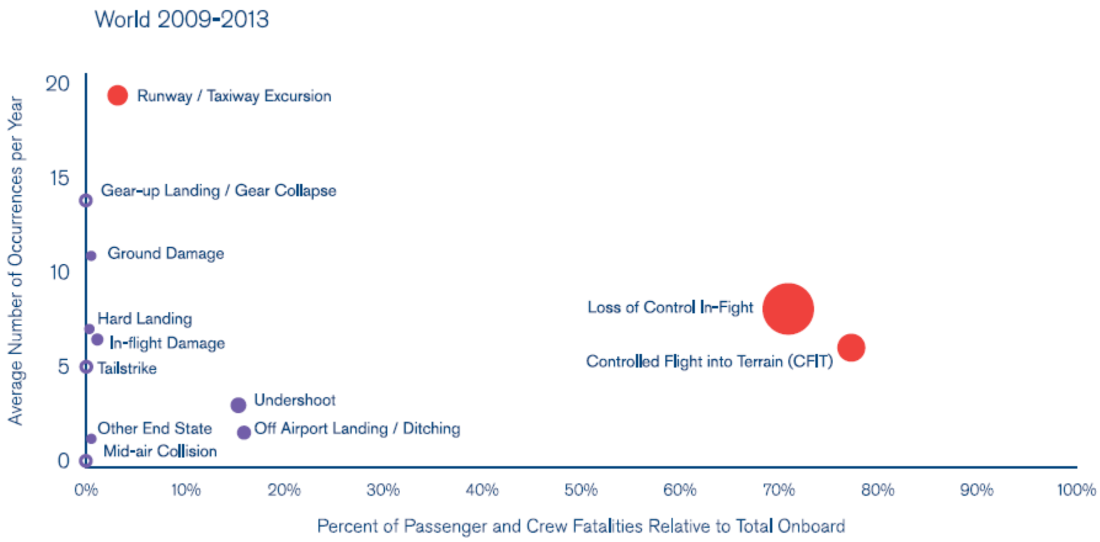

Figure 4: Accidents and fatalities by category (IATA)

**Accidents and fatalities as per IATA categories**

According to the analysis of IATA's (International Air Transport Association) three most important accident categories (marked with the red dot), runway excursion (RE) risks have been consistently reduced. When it comes to the more serious categories it is more difficult to discern a trend – especially as regards LOC-I. It is important to note that the serious CFIT and LOC-I accidents almost exclusively occur to African, CIS countries', Middle Eastern and Latin American airlines. European airlines are extremely rarely involved in fatal accidents. This being the case, it is very difficult to predict the class of a potential accident by means of statistics: if an accident happens it is probably a 'black swan event', i.e. a situation that comes as a surprise. These days, airlines are increasingly trying to improve preparedness for such situations by improving the resilience of their personnel, and their capacity to react correctly even in unexpected situations.

***Risk description***

An airliner accident almost always results in, at the very least, scores, and in the worst case, hundreds of fatalities and serious injuries.

<u>The worst imaginable accident scenario</u> in Finland would be an accident to a large airliner at Helsinki-Vantaa airport. The cause of the accident could be a ground collision on the runway, a collision with the ground or a runway excursion. The most probable cause would be a ground collision between two aircraft or a collision between an airliner and a vehicle on the runway. According to the scenario hundreds of people would die or suffer serious injuries.

While no major airliner accidents have ever happened at Helsinki-Vantaa, different kinds of incidents do occur each year. The most serious incident, similar to the previously mentioned scenario, happened in 1990 when a Finnair airliner collided with a maintenance vehicle on the runway, however, it managed to stay on the runway. Numerous corresponding runway incursions of aircraft and vehicles happen each year. When aircraft are on the ground they are at their most vulnerable because they have no proper safety nets for detecting vehicles or other aircraft on the ground.

Many foreign airlines operate in Finland. In addition, there are often many foreign people among the passengers of domestic airlines. An accident, therefore, would also have large international repercussions outside Finland's borders, and it would attract wide international attention.

An accident anywhere in Finland would likely impact the activities of all organisations operating in the aviation branch (airlines as well as airports) manifesting itself in, at least, a temporary decrease in the number of passengers.

***Description of actions vis-à-vis the risk***

For the most part aviation safety has improved thanks to international regulations. ICAO and EASA lay down the 'rules of the game' in commercial aviation. Among other things, their regulations define continuing airworthiness requirements (design, manufacture, repair and maintenance), and the requirements for air operations and aircrews. Organisations must have a safety management system which includes incident reporting and risk management as its basic elements. At the national level these elements are authenticated when approvals and licences are being granted, and their quality is regularly monitored.

Appendix 2 of the Finnish Aviation Safety Programme (FASP) lists Finland's safety objectives and safety performance indicators. The indicators are divided into three levels or 'tiers'. Tier 1 refers to the number of accidents and serious incidents as well as the number of fatalities; Tier 2 measures the functionality of the system and focuses on certain crucial issues which have been identified as the most common or serious accident types; and Tier 3 was developed by reflecting on the causal factors of the second tier's incident types. In all, there are 57 indicators through which Finland monitors the level of safety. They also include objectives. The objectives of tier 1 indicators are quantitative but, the ones for tiers 2 and 3 are for the most part qualitative at present. Air traffic service providers must assess what steps they will take to reach the objectives, and implement the measures deemed necessary to reduce the risks. FASP is a vehicle for ascertaining whether organisations are taking into account, at the very least, the most significant risks and that they are trying to prepare for them.

Many measures have been implemented to manage the dangers directly associated with the risk as per the scenario. For example, in order to reduce the probability of runway incidents all drivers of vehicles moving in the runway area must have received the proper training, vehicles must be fitted with warning lights and drivers must receive permission from the air traffic control (ATC) to move about in the area. The ATC uses, among other things, ground control radar that makes it possible to monitor the position of all vehicles and aircraft on the ground. Aircrews are to make every attempt, in accordance with their own instructions, to ascertain that the runway is free before they enter it. The risks of runway incursions and excursions are also regularly communicated to those operating in the area.

Following a potential an accident the ATC alerts the aerodrome rescue service and the Emergency Response Centre. International standards and recommended practices require that airports maintain a sufficient number of rescue vehicles and personnel, proportioned to the number of movements and the size of the critical aircraft operating from the airport. Standards also require that within three minutes from an alarm, emergency response vehicles must be able to reach any part of the movement area. To achieve this requirement, there are several rescue stations around Helsinki-Vantaa airport. In addition to the aerodrome rescue service a large number of other emergency personnel and rescue equipment, representing nearby rescue departments and emergency medical care units, would also come to the airport following an accident. Moreover, the Social Emergency and Crisis Center of the city of Vantaa, in addition to its municipal duties, provides nationwide psychosocial support. Furthermore, the air carriers' emergency response plans (ERP) support the actions of the authorities in responding to an accident. The cooperation between the aerodrome, air carriers, the ATC and the rescue services, the social services and health care and the volunteer sector is regularly trained through exercises.

***Evaluating the likelihood of occurrence, impacts and reliability of the scenario***

***Probability***

The worst imaginable accident scenario: a collision between two airliners on a runway at Helsinki-Vantaa airport.

The deep-seated safety thinking in aviation and the procedures through which the safety of flight is pursued (training, backup systems etc.) reduce the probability of an accident.

| **Probability** | **Very low** | **Low** | **Average** | **High** | **Very high** |
|---|---|---|---|---|---|
| | | 2 | | | |

***Risk impact***

Human impacts:

Depending on whether the other party to an accident is a vehicle or another aircraft, the number of fatalities may range from 100–600. In addition to the dead and the injured, the number of uninjured passengers and their families multiply the corollary damage (the number of casualties).

Economic impacts:

An accident would have serious impacts on Helsinki-Vantaa airport and, hence, to Finnish enterprise in toto.

Environmental impacts:

The environmental impacts would remain local and limited.

Societal impacts:

A serious accident at Finland’s main aerodrome would probably also generate serious consequences to different sectors of Finnish society.

| Human impacts | I | II | III | IV | V |
|---|---|---|---|---|---|
| Dead (No) | | | | | > 200 |
| Injured (No) | | | 46-150 | | |
| Evacuated (No) | <= 50 | | | | |
| **Economic impacts** | | | | | |
| Material losses (MEUR) | | | | 100-500 | |
| Consequential loss (MEUR) | | 1-10 | | | |
| **Environmental impacts** | | | | | |
| Environment (sq km) | < 1 | | | | |
| Duration | < wk | | | | |
| **Societal impacts** | | | | | |
| Critical infrastructure (No) | 0-2 | | | | |
| Duration | | | wk - 2 wk | | |
| Vital functions (No) | 0-1 | | | | |
| Duration | | 1 d - 6 d | | | |

### *Predicted reliability*

Many flight safety incident reports have been filed that are relevant to the factors associated with the risk, and a great deal of information from abroad is available as regards the causes and consequences of accidents.

| Predicted reliability | Low | Average | High |
|---|---|---|---|
| | | 2 | |

Overall estimate

| Risk assessment | Probability | Impact assessment | Risk score |
|---|---|---|---|
| | 2 | 2.18 | **4.4** |

## 3.5 A major rail transport accident

### *Background information*

Approximately 36 million tonnes of goods[7] are transported by rail each year. In terms of transport performance this corresponds to approximately 9 million tonne-kilometres[8], i.e. approximately 28%[9] of Finland's total haulage. A little over 5 million tonnes of dangerous goods are transported each year[10]. The lion's share of TDG[11] transports involves transports from Russia to Finland and transit traffic from Finnish ports to Russia. The clearly largest TDG transport flows go from the Vainikkala border post to Sköldvik via Kouvola as well as to the ports of Hamina and Kotka. Domestic rail transports add up to a quarter or so of all TDG transports.

[7] Finnish Railway Statistics 2014, Finnish Transport Agency statistics 2/2014
[8] Finnish Railway Statistics 2014, Finnish Transport Agency statistics 2/2014
[9] Transport and Communications Statistical Yearbook for Finland 2014. Statistics Finland
[10] Vainiomäki Ville, A brief analysis: Accidents and incidents in transporting dangerous substance on railways, Trafi 2014
[11] TDG = Transport of Dangerous Goods

The number of journeys made each year in railway passenger traffic is 69 million[12]. The largest part of passenger traffic is commuter traffic in the Helsinki area which amounts to approximately 80%[13] of all journeys made. The remaining 20% are long-distance journeys.

Information regarding all railway accidents since 1924 was made available to the working group. According to this information, no accidents corresponding to the scenario have occurred in Finland. Of all accidents, the following ones – in slightly different circumstances – could have resulted in a situation resembling the scenario.

- The derailing of tank container wagons on a main line caused a serious accident. In Riihimäki, on 27 October, 1996 some tank wagons started to move on their own following which they derailed. Among the wagons were forty-seven loaded wagons carrying liquid gas. One of the wagons turned over and landed across the main line, blocking both tracks of the line, which resulted in a main signal displaying a 'stop' aspect, thereby stopping the approaching fast train. Only a moment before another fast train had passed the site. The risk of a major accident was evaluated as follows in an expert statement, annexed to the investigation report: "In summary it can be stated that, taking into consideration a collision and the chemicals present in the wagons, the collision of a passenger train with the obstruction formed by the wagons would have caused a major accident which, in turn, would have resulted in scores of fatalities and injured persons. The impacts of the accident would have extended far and wide, and the rescue operation would have been difficult"
- On 16 June 2009 ten freight train wagons derailed in Toijala. Five of the wagons tipped over. The speed of the train at the moment of derailment was 70km/h. Safety equipment, parts of the track, and electric railway equipment were damaged in the accident. Safety devices and communications connections were disrupted in Toijala and at the nearest operating points. As a result of the accident, train traffic was totally interrupted for 5.5 hours. Traffic returned to normal 15 days after the accident.

***Risk description***

A freight train carrying flammable liquids derails close to a population centre. The speed of the train at the moment of derailment is 80 km/h. Some of the tank wagons derail and tip over onto the parallel track.

Simultaneously, a fast train is approaching from the opposite direction and it is either too late to inform it of the accident or there is simply no word of the accident at that stage. When the freight train derails the passenger train is already so close that, despite emergency braking, a collision with the derailed tank wagons lying on the track is unavoidable.

The passenger train collides with the tank wagons at 120 km/h. As a result of the collision the tank wagons rupture, releasing dangerous and flammable substances. Some wagons burst into flames.

When the passenger train hits the derailed freight wagons some passengers sustain serious or mild injuries. As the freight wagons hit the side of the passenger train, more passengers are seriously injured or die. The passengers are exposed to dangerous substances and the fire. This results in more, perhaps even scores of, serious injuries and deaths. The evacuation of passengers is difficult, which continues their exposure to the hazards.

The accident severely damages the railway structures, cutting off rail traffic completely. Also, railway overhead line as well as signalling and safety equipment and cabling are damaged. It takes several

[12] Finnish Railway Statistics 2014, Finnish Transport Agency statistics 2/2014
[13] Finnish Railway Statistics 2014, Finnish Transport Agency statistics

days to repair the damage, during which time railway transport is interrupted. This causes huge problems and generates knock-on effects to railway transport all over Finland.

The leakage of dangerous substances and the fire cause a toxic cloud, which is then carried by the wind towards the population centre. Should this happen in daytime, there would be many people in the population centre whose safety the toxic emission would jeopardise. At nighttime there are fewer people moving about, but it is more difficult to reach and warn them. This could result in serious injuries.

***Description of actions vis-à-vis the risk***

Railway undertakings are responsible for the condition of railway rolling stock. Maintenance is based on periodic inspections and maintenance, carried out in accordance with the railway rolling stock safety management system. The procedures are described in the safety management system of the railway undertaking.

The railway infrastructure manager is responsible for the condition and upkeep of the rail network. Rail maintenance and inspection intervals, and maximum tolerances, are specified by technical manuals and regulations. They are included in rail network maintenance contracts. Furthermore, specially designed track inspection vehicles check the condition of the tracks 1–6 times per year, depending on the quality level requirement of the section. The railway infrastructure manager monitors the condition of the rolling stock using the rail network by means of wayside hot-box detectors and wheel force indicators. The indicators provide information on potential equipment failures in rolling stock; this information can be used to order pre-emptive or immediate maintenance for the affected rolling stock. Moreover, if the conditions of the equipment so warrants, a train can be stopped immediately.

The railway infrastructure manager and railway undertakings have established practises for accident mitigation by issuing relevant instructions, including responsibilities and procedures.

Finnish marshalling yards categorised as TDG yards are mostly situated in or around urban areas. TDG yards are among the installations that have major-accident potential, and the operator and the rescue department in the region must plan for accidents that may occur there. The responsibility of the operator is to draft a safety report and an internal safety/rescue plan which identifies the dangers and risks at such a yard. On the basis of the safety plan the local rescue department must draft an external safety/rescue plan for the yard. Such a contingency plan must include all required firefighting and rescue actions which can limit and control the consequences of a potential major accident at the railway yard, and minimise the impacts to the population and the environment. The external safety/rescue plan must be drilled, at the very least, every three years.

The actions included in railway yards' external safety/rescue plans are also feasible in rail transport accidents that occur outside the railway yard or close to a population centre. When it comes to a passenger traffic accident (major accident) only, the rescue department's rescue operation and the dispatched rescue formations follow the same principles that are included in the external safety/rescue plan. The only difference is that, due to the large number of potential casualties in this kind of an accident, the importance of emergency medical care and the subsequent health care chain is highlighted. Rescue departments must determine the biggest accident risks and threats in their Service Level Decisions and, simultaneously, decide the scope of resources allocated to the response. Consequently, the rescue department drafts the alerting instructions upon which the ERC will dispatch all pre-planned and appropriate units to the accident site.

*Evaluating the likelihood of occurrence, impacts and reliability of the scenario*

*Probability*

The probability of an accident as per the scenario is estimated to be **average** (once every 100–500 years). Since no such accidents have ever happened in Finland, the evaluation is based on expert estimates.

While the probability of individual factors occurring in the scenario is higher, the likelihood of their concurrent occurrence which would result in an accident such as the one described above is average.

| Probability | Very low | Low | Average | High | Very high |
|---|---|---|---|---|---|
| | | | 3 | | |

*Risk impact*

Human impacts:

The risk will immediately impact scores of people on the accident passenger train. The accident will cause tens of fatalities or seriously injured people. A toxic leak will, likewise, affect at least scores of people in any nearby population centre. In all, the direct and indirect impacts involve hundreds of people.

Economic impacts:

The immediate costs of the accident are at least hundreds of thousands of euros. The aforementioned costs mainly impact the railway infrastructure and the railway undertaking. Other costs are incurred by, among others, passengers and the industries that use rail freight services and by the trade and commerce whose rail transports are interrupted or held back.

Environmental impacts:

The accident generates a massive release which, ultimately, remains local and which can be recovered from. However, depending on the location, it can also cause long-term harm. Immediately following the accident the area affected is larger because of the toxic release into the atmosphere.

Societal impacts:

The accident is believed to have a serious societal impact. Because of the toxic leak scores of people have to be evacuated. Moreover, an accident may cause people to lose their sense of safety and security, and a change in their attitudes towards rail transport. An accident would have wide and significant repercussions on rail transport all over Finland.

| Human impacts | I | II | III | IV | V |
|---|---|---|---|---|---|
| Dead (No) | | | 16-50 | | |
| Injured (No) | | | 46-150 | | |
| Evacuated (No) | | | | 501-2,000 | |
| **Economic impacts** | | | | | |
| Material losses (MEUR) | | | 10-100 | | |
| Consequential loss (MEUR) | | | 10-100 | | |
| **Environmental impacts** | | | | | |
| Environment (sq km) | | 1-10 | | | |
| Duration | | < mo | | | |
| **Societal impacts** | | | | | |
| Critical infrastructure (No) | | 3-4 | | | |
| Duration | | | wk - 2 wk | | |
| Vital functions (No) | 0-1 | | | | |
| Duration | | | wk - 2 wk | | |

### *Predicted reliability*

The predicted reliability is average, 2. No corresponding accident has ever happened in Finland but, judging by causal factors and lessons learned, it can be seen that the justifications for the evaluation are quite sufficient.

| Predicted reliability | Low | Average | High |
|---|---|---|---|
| | | 2 | |

### *Overall estimate*

The human impacts play the key role in evaluating the impacts of rail transport accidents and in planning risk assessment measures. However, this was not factored into the aforementioned overall impact assessment. Rather, the impact was calculated as the arithmetic average of the relevant criteria.

| Risk assessment | Probability | Impact assessment | Risk score |
|---|---|---|---|
| | 3 | 2.64 | **7.9** |

## 3.6 A major road traffic accident

### *Background information*

Over 200 people die each year in Finnish road traffic – most of them on the highways. The national goal, which is also the EU's recommendation, is to halve the number of road fatalities by the end of this decade. In 2014 there were 224 road fatalities. Approximately 6,700 road injuries are reported to the police annually, and nearly 23,000 injured persons receive traffic insurance compensation each year. In the early 2010s the annual count of serious injuries was estimated at 1,400, when calculated in accordance with the EU-recommended definition of a serious injury[14]. There are approximately 900 serious injuries in the database of the emergency and rescue services' Pronto online statistics. Road accidents that result in fatalities or injuries are regrettably commonplace. Serious injuries often stem from head-on collisions, veering off the road or vehicles colliding with pedestrians, bicycle riders or moped rides.

A road accident which results in at least four fatalities is categorised as a major road accident. The Safety Investigation Authority investigates such accidents, which occur every other year on average. Four accidents that have taken the lives of at least ten persons have happened since the Second World War. Each one was a coach accident, of which the most serious was the accident at Konginkangas on 19 Mar 2004 involving a heavy vehicle combination and a charter coach, which resulted in 23 fatalities.

Approximately 70 people die and 600 are injured each year in accidents where at least one of the vehicles involved is a heavy vehicle. Heavy vehicle accidents that result in fatalities are often head-on collisions on the main highways.

Since a coach carries more passengers than any other vehicle on the road, the number of casualties can be high. Approximately one quarter of the seats on a coach is occupied, on average.

Coach drivers and passengers die in traffic accidents more seldom than once a year; approximately 60 of them are injured each year. When injuries are proportioned to person-kilometres, coach travel is safer than any other form of road traffic. For the most part coach passengers sustain injuries when coaches veer off the road, have accidents in intersections or collide head-on with other vehicles.

Road traffic accidents cause loss of life and limb, damage to vehicles and road infrastructure as well as releases of dangerous substances into the environment, traffic congestion, and the need to provide alternative routes, information channels included. It is sometimes challenging to guide the emergency medical services and clearance units to the accident site, especially in winter conditions.

In road traffic the term 'accident risk' normally means the number of accidents proportioned to some variable that describes exposure. The most typical risk metrics of this kind are the accident frequency and the accident incidence rate, and the number of accidents per capita. Accident frequency is calculated by dividing the number of accidents with road length. Accident rate is produced by dividing the number of accidents by the yearly traffic exposure on the corresponding road sector. The term 'risk factor' normally refers to the factors that an accident investigation group considers to have affected the causes and consequences of an accident.

***Risk description***

An occurrence that is highly probable in Finland has been selected as the scenario of a major road traffic accident. One party to the accident is a coach in which at least four people die. A clearly larger accident as to its impact could involve a collision between a chemical tanker and a coach, following which dangerous chemicals could leak into the environment at the accident site. This accident scenario, however, is unlikely and, therefore, it was not selected.

In the situation as per the scenario, a sport utility vehicle (SUV) begins to overtake a coach and, simultaneously, a small passenger car turns onto the highway from an intersection and sets off in the opposite direction. The SUV and the car collide, and the coach veers off the road and rolls over on a river bank. As a result, the couple in the passenger car die instantly and both the father of the family

[14] Noora Airaksinen and Matti Kokkonen: Assessment of the number of serious injuries sustained in road traffic. VAAKKU study. Trafi Research Reports 10/2014.

driving the SUV as well as his teenage child in the front seat die. The mother and the younger sibling sitting in the back sustained serious injuries. The tour guide sitting in the front seat of the coach drows in the river, the some of the passengers only sustain minor injuries.

***Description of actions vis-à-vis the risk***

Even though major road accidents are relatively rare, more than 200 road fatalities and thousands of disabilities of varying degree stem from different kinds of accidents each year. First and foremost, in road safety related work it is important to select the kinds of actions which cost-effectively affect the largest possible number of accidents. Accidents have manifold underlying factors and, consequently, there are many instruments and competent actors to choose from when improving traffic safety in transport system. The following lists certain important measures which could reduce the aforementioned risks.

The most effective way to prevent head-on collisions between opposing lanes is to use crash barriers or central reservations. Apart from motorways, lane separation exists on less than 200 km of roads in Finland. The ever-evolving vehicle technology, such as automatic lane departure warning systems, combined with clear road markings, will reduce the risk of a vehicle leaving its lane and losing control. The rate at which new vehicles supersede older ones and the inclusion of present accessories as standard equipment will affect the proliferation of modern technology.

Roads have been assigned winter maintenance service classes because it is impossible to immediately carry out uniform road maintenance everywhere with reasonable costs. The busiest roads are for the most part clear even in the winter. The Traffic Management Centres of Transport Agency as well as the weather centres of maintenance contractors monitor the state of weather and road conditions as well as road tunnels. They relay the information to the appropriate winter maintenance contractor. Road users are informed of poor road conditions through weather reports in the media, the Finnish Transport Agency's Internet traffic information service, and in traffic information bulletins on the radio.

The use of seatbelts in coaches became mandatory in 2006. Nowadays, it is compulsory to use seat belts in all coaches, if there is one installed in the seat. Already since 1999 new long-distance coaches have had to have seat belts installed in every seat. The general public is reminded of the importance of seat belts in both coaches and other vehicles through campaigns.

Police traffic surveillance focuses particularly on driving speeds and drink-driving. Traffic surveillance is increasingly making use of new technologies such as speed cameras and automatic number plate recognition systems.

The automatic emergency call system, the eCall, will automatically transmit an emergency message and the exact location of a crash site to the nearest Emergency Response Centre following an accident and thus hasten the arrival of assistance to the site of the accident. The first cars and vans to utilise the public eCall service will probably enter the Finnish market in late 2017.

The authorities and road traffic associations will promote the introduction of quality systems facilitating increased safety in commercial transport in connection with, among other things, competitive bidding.

All commercial vehicle operators have had to have professional qualifications since 10 September 2014. The purpose of professional qualifications is to improve the drivers' professional skills and, hence, increase safety in traffic and transports.

***Evaluating the likelihood of occurrence, impacts and reliability of the scenario***

***Probability***

The probability of an accident as per the scenario is high.

*Statistics and a recurrence estimate*

Accidents of this severity occur once every few years. It is estimated that the volume of coach traffic will remain at a constant level for the near future. Heavy vehicle combination traffic, it is estimated, will increase somewhat. Improving the vehicles and the road network could reduce the probability of an accident, and mitigate its consequences to some degree, compared to previous decades.

| Probability | Very low | Low | Average | High | Very high |
|---|---|---|---|---|---|
| | | | | 4 | |

***Risk impact***

Human impacts:

Causes fatalities and injuries and disabilities of some degree to some people. The impacts to those who avoided the actual crash are momentary (being late, the need to find an alternative route). If the situation involves a fire, the health threats include harmful gases and even burns.

Economic impacts:

The economic impacts are significant to individuals or business owners such as the owners of transport companies or, possibly, to consignors. The injuries may also result in the loss of work ability or in the need for retraining. It burdens health care resources. The costs of repairing road equipment and structures vary.

Environmental impacts:

The environmental impacts are normally local, depending on the substances leaking from the vehicles. The accident may result in the need to exchange and remediate the contaminated soil or protect the water table.

Societal impacts:

The impacts of a traffic accident on critical infrastructure and society’s vital functions are negligible.

| **Human impacts** | **I** | **II** | **III** | **IV** | **V** |
|---|---|---|---|---|---|
| Dead (No) | | 6-15 | | | |
| Injured (No) | | 16-45 | | | |
| Evacuated (No) | <= 50 | | | | |
| **Economic impacts** | | | | | |
| Material losses (MEUR) | | 1-10 | | | |
| Consequential loss (MEUR) | < 1 | | | | |
| **Environmental impacts** | | | | | |
| Environment (sq km) | < 1 | | | | |
| Duration | < wk | | | | |
| **Societal impacts** | | | | | |
| Critical infrastructure (No) | 0-2 | | | | |
| Duration | < d | | | | |
| Vital functions (No) | 0-1 | | | | |
| Duration | < d | | | | |

### *Predicted reliability*

This is an expert evaluation, based on prior development and a forecast of the number of vehicles and infrastructure.

| **Predicted reliability** | **Low** | **Average** | **High** |
|---|---|---|---|
| | | 2 | |

### *Overall estimate*

| **Risk assessment** | **Probability** | **Impact assessment** | **Risk score** |
|---|---|---|---|
| | 4 | 1.27 | **5.1** |

## 3.7 Several simultaneously occurring major forest fires

### *Background information*

The Ministry of the Interior has provided Pronto accident statistics since 1996. In an international comparison, the number of Finnish forest fires has been quite modest. From 1996–2015 the worst year for forest fires was 2006, when nearly 3,000 fires scorched approximately 1,600 hectares of forest. Only in 1997 and 2006 had more than 1,000 ha burned. From 1996–2015, on average, the approximately 1,300 annual forest fires destroyed less than 600 ha of forest each year. The average area of a forest fire, therefore, has been 0.4 ha, i.e. 4,000 square metres.

As far as is known, the largest forest fire in recent years was the Tuntsa fire in 1960. It destroyed more than 100,000 ha of forest in the USSR and 20,000 ha on the Finnish side of the border, as well. The most recent major forest fire happened in 2014 in Sweden; a total of 17,000 ha of forest burned in that fire.

***Risk description***

In Finnish conditions forest fires obviously develop in the summertime, when large forest fires are also possible in Finland. Wide forest areas burn each year on the Russian side, and several fires are also near our border. The situation would become particularly challenging should several large-scale forest fires flare up simultaneously close to populated areas.

The smoke from the fires constitutes the greatest threat to humans. It can be so dense that inhabited areas need to be evacuated. It is unlikely that forest fires would spread to urban structures because, normally, the woods around populated areas are not dense enough to sustain a fire.

If there are several large forest fires burning simultaneously, Finland's aerial firefighting equipment would probably not suffice. On the one hand, rescue departments must allocate a lot of resources to firefighting, but, on the other hand, they must concurrently maintain preparedness for other types of accidents. This means that firefighting units would have to be dispatched from several rescue service regions.

When it comes to large forest fires people are typically rescued, but property damage can climb to a high level. A fire will cause damage to forestry and most likely also to other property. Even though this text mainly addresses large fires, the impacted area is still relatively confined.

Most forest fires are caused by human carelessness and indifference. Approximately 10% of all forest fires are started by lightning.

***Description of actions vis-à-vis the risk***

The conditions in Finland differ greatly from those in Central Europe. Finland is a flat country with lots of lakes and rivers as well as forest roads. The climate is cool and for the most part of the year there is no risk of forest fire. In practice, the forest fire season extends from May to September. These conditions have made it easier to establish an effective forest fire fighting system.

Roughly speaking, Finland's forest fire fighting system stands on three pillars: prevention, early warning, and effective suppression. The forest fire warning system is the prerequisite for prevention. The Finnish Meteorological Institute (FMI) publishes a daily forest fire index and when the index exceeds 4 on a 1–6 scale the Finnish Meteorological Institute issues a forest fire warning for areas where, on account of dry soil and weather conditions, the risk of forest fires is deemed to be manifest. Pursuant to the Rescue Act (379/2011) *Campfires or other open fires may not be lit if, because of drought, wind or other reasons, the conditions are such that there is a manifest risk of a forest fire, grass fire or other fire*.

A forest fire warning also triggers forest fire observation flights. When the index remains below 5, such flights are normally flown once per day and, when the index exceeds the value of 5, they can be flown twice per day. There are in all 26 forest fire observation flight routes, covering all of Finland. The purpose of these flights is to detect forest fires as soon as possible.

Another principle which facilitates early warning is the principle laid down by the Rescue Act, according to which *Anyone who observes or receives information about a fire or other accident that is either occurring or about to occur… is obliged to notify those endangered, make an emergency call and take rescue action without delay to the best of their abilities*. Mobile phones have especially expedited the emergency calls, making it possible for the Emergency Response Centre to dispatch a rescue department to the site as soon as possible. Finland also uses a satellite-based forest fire warning system, which is unique in the world. The satellite can normally detect all forest fires exceeding 3 ha and transmit an alarm to the nearest Emergency Response Centre in less than 30 minutes. This type of system would not work in southern Europe because the soil temperatures there are so high that the number of false alarms would grow to an unacceptable level.

Prevention as well as rapid detection and alerting are augmented by the efficient and rapid rescue service organisation. Because the network of forest roads is so extensive in Finland, rescue vehicles can get close to the fire and, thanks to the countless lakes, there is almost always enough water available nearby. The water bodies also act as natural firebreaks. Finland has a dense network of rescue departments; the average response time in all parts of the country is less than 10 minutes. As forest fires normally burn far away from population centres, it takes longer for fire units to reach the sites. In spite of this, the average area scorched by a forest fire in Finland is less than half a hectare, and the total area burned each year remains below 1,000 ha.

***Evaluating the likelihood of occurrence, impacts and reliability of the scenario***

***Probability***

The likelihood of the scenario is estimated to be average (occurs once every 100–500 years). Whereas Finland experienced the Tuntsa forest fire in 1960 and Sweden the fire of 2014, which was nearly as extensive, no large forest fires have occurred simultaneously in different parts of the country. It is estimated that global warming will increase the likelihood of favourable conditions for forest fires in Finland as well.

| Probability | Very low | Low | Average | High | Very high |
|---|---|---|---|---|---|
| | | | 3 | | |

***Risk impact***

Human impacts

The accident will directly impact scores of people through smoke inhalation or other possible injuries. Transboundary smoke haze pollution can expose a large number of people to the health hazard; at special risk are those who already suffer from pulmonary-vascular diseases. The smoke haze pollution can worsen their condition, resulting in premature death.

Economic impacts:

At the end of the day, forest fires, for the most part, have a limited impact on individual actors or sectors, and would be relatively easy to control. Whereas the impacts to individual people can be disastrous, society can manage them well.

Environmental impacts:

The fire would cause a relatively small and far-reaching, but fairly short-lived emission.

Societal impacts:

The accident is considered to have a serious societal impact. While it would cause extensive evacuations, the total number of people to be evacuated would remain below 4,000. Smoke haze pollution could also entail widespread societal impacts in those areas and circumstances where an evacuation is not yet needed. The smoke haze can force restrictions for smoke-sensitive people as regards moving outdoors for extended periods. Large forest fires would also cause problems to traffic and logistics, and damage to the electric network.

| Human impacts | I | II | III | IV | V |
|---|---|---|---|---|---|
| Dead (No) | | 6-15 | | | |
| Injured (No) | | | 46-150 | | |
| Evacuated (No) | | | | | > 2,000 |
| **Economic impacts** | | | | | |
| Material losses (MEUR) | | | 10-100 | | |
| Consequential loss (MEUR) | | 1-10 | | | |
| **Environmental impacts** | | | | | |
| Environment (sq km) | | | 10-100 | | |
| Duration | < wk | | | | |
| **Societal impacts** | | | | | |
| Critical infrastructure (No) | 0-2 | | | | |
| Duration | | 1 d - 6 d | | | |
| Vital functions (No) | 0-1 | | | | |
| Duration | | 1 d - 6 d | | | |

***Predicted reliability***

Predicted reliability is average. Finland has not had a situation in which several large forest fires were ablaze simultaneously in different parts of the country. Nevertheless, the large forest fires in recent history indicate that a situation such as this is entirely possible.

| Predicted reliability | Low | Average | High |
|---|---|---|---|
| | | 2 | |

***Overall estimate***

| Risk assessment | Probability | Impact assessment | Risk score |
|---|---|---|---|
| | 3 | 2.27 | **6.8** |

## 3.8 A major building fire at infrastructure critical to society

***Background information***

Critical infrastructure encompasses the structures and functions which are vital to the uninterrupted functioning of society. Critical infrastructure comprises physical installations and structures as well as electronic functions and services. In order for them to be secured they must be identified and safeguarded, while at the same time an eye must be kept on the functioning of infrastructure as a whole.

Fires happen at critical infrastructure sites every year. The Safety Investigation Authority investigated hospital fires that took place at Pitkäniemi Hospital in Nokia in 2007, in an operating theatre at Meilahti Hospital in Helsinki in 2009, and at Turku University Hospital, where a fire created the risk of a major accident in 2011. In the 2011 hospital fire in Turku the smoke spread almost throughout the entire building. Three nurses suffering from smoke exposure were taken to the health centre. In all, 176 patients and 56 staff members were evacuated from the building. According to the Safety Investigation Authority total damage, including consequential loss, is estimated at EUR 17.5 million.

***Risk description***

Large fires are local, yet possible at nearly any site. Normally, large fires are the result of human error or negligence; they also share the characteristic of there being simultaneous, mutually exacerbating errors. It is possible that the fire doors at the target are wedged open, which invalidates the purpose of fire sectioning. In such a case the fire can spread explosively throughout most of the building. It is also commonplace that the inlets for cables, etc., are not sealed. Then, too, the fire sectioning fails and the fire can rapidly spread from one fire section to another. This especially concerns sites which are not protected by automatic fire extinguishing systems or fire alarm systems.

As regards critical infrastructure it can be stated that major fires are isolated, local events which have only local bearing on the critical infrastructure mentioned in the associated Government Resolution. At its worst, a major fire causes fatalities, economic damage and disruptions to critical production or services. However, critical production and services are generated in such a dispersed manner that damage at an individual location will not entirely paralyse their functioning.

When the probability and potential consequences of a major fire are being evaluated, one of the most serious threats involves a major fire at a large university hospital. This would result in a permanent, or at least temporary, interruption in the functioning of the hospital. The fire itself would probably result in fatalities and many injuries because hospital patients are often not self-ambulatory, capable of escaping the fire. This means that the nursing staff and the rescue department would have to devote a large part of their resources to rescuing and evacuating patients at the expense of firefighting.

The fire itself would cause extensive damage and result in the hospital having to terminate its operations. Its services would then have to be provided through alternative arrangements. A fire would cause considerable property damage in the form of destroyed premises and equipment.

***Description of actions vis-à-vis the risk***

Hospitals are not normally protected by automatic fire extinguishing systems, but many of them have fire alarm systems. University hospitals are located in big cities where emergency and rescue services are on call 24/7 – within a minute’s response requirement. Therefore, it is possible to dispatch resources to the site in a relatively short period of time. These kinds of arrangements make it possible for the ERC to receive rapid automatic reports of initial fires, which can then promptly dispatch the rescue department to the site.

Nursing homes and other institutional care facilities are sites which, pursuant to the Rescue Act, must have emergency plans and draw up evacuation safety reports. Under the Act the operators must, *by using reports and plans drawn up in advance and by taking measures based on them, ensure that the residents and the persons being treated are, in the event of a fire or other dangerous situation, able to leave the building safely, either on their own or with assistance.* This applies to all such premises and spaces whose occupants have limited functional capabilities, such as hospitals. In practice, this means that the preparedness for evacuation at hospitals is superior to the average target because the arrangements are planned from the perspective of the evacuation safety report.

***Evaluating the likelihood of occurrence, impacts and reliability of the scenario***

***Probability***

The probability of an accident as per the scenario is estimated to be average (once every 100–500 years). Since no such accidents have ever happened in Finland, the evaluation is based on expert estimates.

| Probability | Very low | Low | Average | High | Very high |
|---|---|---|---|---|---|
| | | | 3 | | |

***Risk impact***

Human impacts:

The accident would result in scores of fatalities or serious injuries. As a whole, the impacts would extend, via direct and indirect consequences, to hundreds of people.

Economic impacts:

The fire would have a limited impact on individual actors or sectors. However, backup arrangements could compensate for it.

Environmental impacts:

The fire would release negligible, local emissions into the environment.

Societal impacts:

The accident is believed to have a fairly serious societal impact. It would necessitate the evacuation of scores of people. An accident would also result in an interruption to the provision of health care services.

| **Human impacts** | **I** | **II** | **III** | **IV** | **V** |
|---|---|---|---|---|---|
| Dead (No) | | | | 51-200 | |
| Injured (No) | | | 46-150 | | |
| Evacuated (No) | | 51-200 | | | |
| **Economic impacts** | | | | | |
| Material losses (MEUR) | | | 10-100 | | |
| Consequential loss (MEUR) | | | 10-100 | | |
| **Environmental impacts** | | | | | |
| Environment (sq km) | < 1 | | | | |
| Duration | < wk | | | | |
| **Societal impacts** | | | | | |
| Critical infrastructure (No) | 0-2 | | | | |
| Duration | | | wk - 2 w | | |
| Vital functions (No) | 0-1 | | | | |
| Duration | | | wk - 2 wk | | |

### *Predicted reliability*

The predicted reliability is average, a 2. No corresponding accident has ever happened in Finland but, judging by causal factors and lessons learned, it can be seen that the justifications for the evaluation are quite sufficient.

| Predicted reliability | Low | Average | High |
|---|---|---|---|
| | | 2 | |

### *Overall estimate*

| Risk assessment | Probability | Impact assessment | Risk score |
|---|---|---|---|
| | 3 | 2.27 | **6.8** |

## 3.9 An extensive or extended disruption in water supply

### *Background information*

A serious water supply disruption and a health hazard can arise from a contaminated water source, or from the consumption of contaminated household water distributed by the water supply plant. In 2007 over 8,000 people in the city of Nokia became ill when 400 $m^3$ of treated wastewater (technical water) was accidentally allowed to enter the distribution network. The number of ill people was relatively high because the technical water spread widely inside the distribution network, and a copious amount of various kinds of pathogens also got into the network. The estimated cost rose to approximately EUR 1.5 million.

In addition to microbiological risks, various chemicals in household water, such as iron and manganese present in groundwater and tap water, as well as pesticides or petrol additives that smell and taste bad can cause household water supply disruptions and shut down water abstraction sites. In addition to microbiological and chemical parameters in drinking water, the future Drinking Water Decree will also lay down provisions on radioactivity monitoring.

The availability and quality of drinking water can decline during widespread and long-lasting power outages. Storm Tapani caused power outages for 80% of the affected regions' water supply plants, which the consumers experienced in water supply interruptions and quality problems in drinking water caused by reversed water flow directions. The biggest demand for electricity in water supply involves pumping, which encompasses the entire production process ranging from the abstraction of raw water to purification and distribution. During a widespread power outage it is impossible to maintain sufficient water pressure in the distribution network, and the risk of contamination grows when there is no pressure in the network. Moreover, an extensive power cut also often causes telecommunication problems which, in turn, renders the water supply plants' remote monitoring systems inoperative, especially as regards geographically wide water supply systems.

A prolonged drought will cause much fewer water distribution problems in Finland compared to many other countries. Owing to our abundant water resources such problems can only be caused by a relatively long period of lower-than-average precipitation in Finland, lasting more than a year. Nevertheless, it is estimated that the prevalence of extreme meteorological and hydrological phenomena stimulated by climate change will increase the risk of drought-generated water distribution problems, at least to a degree, and the need for preparedness. The importance of sufficient alternative water sources is emphasised in the development and advancement of water supply.

More than drought, floods and torrential rains have caused water quality problems. Climate change increases their likelihood in Finland, as well. Heavy rains and strong floods that move soil have particular impact on the quality of raw water when surface water or artificial groundwater is used as the source for raw water. At their worst, river floods and torrential rains can overload dilapidated sewer pipelines and increase the risk of uncontrolled sewage flow. This, in turn, always presents a risk to the production and distribution chain of household water. The risk of surface waters entering isolated wells and groundwater abstraction points in sparsely populated areas grows during extreme weather events, floods and continuing downpours. Unprotected groundwater abstraction sites and open spaces at water supply plants, or well covers are, as such, vulnerable to accidental or intentional interference.

***Risk description***

Large urban areas as well as functions that require a lot of water, such as hospitals and the food industry, are extremely vulnerable to serious disruptions in water supply. In order to secure these functions safe and sufficiently high-yield water sources, efficient production and distribution process monitoring as well as backup systems must be available in all conditions.

Any contamination of a raw water source or the household water distributed to the customer by the water supply plant can originate from a natural phenomenon, environmental disaster or technical fault. However, the water supply system, due to its irreplaceability and networked character, is also vulnerable to intentional interference. The typical risk for water supply arising from a long drought is a shortage of water for households and commercial activities in rural areas that rely on their own groundwater sources.

***Description of actions vis-à-vis the risk***

The amendment of the Water Services Act, which entered into force as of September 2014, sets new requirements for contingency planning and water supply plants by, among other things, laying down provisions on the water supply plant’s duty to obtain information regarding the risks to the volume and quality of its raw water. Guidance will also improve preparedness; an example of this is the project for a water supply plant’s disruption preparedness manual, launched by the National Emergency Supply Agency’s Water Pool.

Section 8 of the Health Protection Act (763/1994) obligates the Finnish National Supervisory Authority for Welfare and Health (Valvira) to draw up a plan for safeguarding the supply of household water in view of accidents and comparable exceptional circumstances; and the municipal health protection authority, together with other authorities and departments, to prepare against health hazards caused by exceptional circumstances. The Decree of the Ministry of Social Affairs and Health relating to the quality and monitoring of water intended for human consumption (461/2000) and the Decree of the Ministry of Social Affairs and Health relating to the quality and monitoring of water intended for human consumption in small units. (401/2001) as well as Valvira’s handbook “Exceptional Situations Related to Environmental Health” lay down more detailed provisions on preparedness for special situations.

Risks must also be reduced by investing in alternative means of water supply if the situation at the water supply plant, in this regard, is unsatisfactory. Several projects of this kind are underway. In addition, the preparedness for and functioning of temporary water distribution arrangements must be constantly improved and drilled. Preparedness against distribution interruptions caused by sustained droughts must be improved as part of overall water supply contingency planning.

Under the leadership of the Ministry of Social Affairs and Health the Water Safety Plan (WSP) / Sanitation Plan (SSP) risk management program was developed for health and environmental hazard prevention at water supply plants. By using this risk management program water supply plants are able to prepare for different exceptional circumstances and disruptions, and draw up contingency and monitoring plans.

Guaranteeing the safety of household water calls for the systematic control of the entire water distribution chain from the water source to sewage disposal. The web-based WSP/SSP risk management program makes it possible for waterworks to identify the critical, dangerous nodes in their production chain, to carry out a risk assessment and determine the means and measures needed in managing the risks exposed by the process. In order to make the risk assessment easier the program provides hazard-specific additional information on the health effects and prevalence of chemical and microbiological parameters.

***Evaluating the likelihood of occurrence, impacts and reliability of the scenario***

***Probability***

The WSP/SSP risk management program uses the following risk evaluation table in which risk, as per the general risk model, is the probability of the hazard times its consequences. In order to make the assessment of probability and risk easier the program provides hazard-specific additional information on the health effects and prevalence of chemical and microbiological parameters.

| L=Low (low risk), no immediate attention required<br>M=Moderate (average risk), attention required to control risk; draw up plan and schedule for risk management<br>H=High (critical), attention required to control risk; immediate action necessary | | | Consequence | | | |
|---|---|---|---|---|---|---|
| | | | No health hazard, no notable effect<br>No effect (1) | Exceeds acceptable chemical threshold or taste, odour and aesthetical threshold<br>Little effect (2) | Exceeds acceptable microbiological threshold, radioactive<br>Significant (3) | Exceeds acceptable quality threshold and/or water use causes an epidemic or other health hazard<br>Serious (4) |
| Likelihood of occurrence | More seldom than once every ten years | Rare (1) | L | L | M1 | H1 |
| | Once every 5-10 years | Sporadic (2) | L | L | M2 | H2 |
| | Once every 1-5 years | Possible (3) | L | M2 | H2 | H3 |
| | More often than once a year | Likely (4) | L | M3 | H3 | H4 |

Figure 5: WSP/SSP risk management program

Most recently a prolonged drought caused water supply problems from 2002–2003. In the light of modern knowledge the risk of recurrence can be considered high (once every 10–20 years). From 2002–2003 most of the regional problems were experienced in southwestern Finland, especially in rural area water supply.

| Probability | Very low | Low | Average | High | Very high |
|---|---|---|---|---|---|
| | | | | 4 | |

***Risk impact***

An interruption in water supply or a decline in household water quality can pose a serious threat to the life and health of humans, and many vital functions of society. A disruption in waste water management can generate serious consequences to the environment and nature. An interruption in water supply can rapidly degrade sanitation in a densely populated urban area. Waterborne microbes or other harmful substances in the water distribution network can rapidly unleash a widespread, serious epidemic. A water epidemic can be halted by means of public communication, temporary water distribution measures, purifying the water network (disinfection) and by bringing backup water supply measures online.

In Finland the abstraction of water in large population centres typically happens at remarkably high yield water sources and, for the most part, in such a manner that two mutually independent water sources are available. Hence, even prolonged droughts are not estimated to create any significant problems for the operation of large water supply plants, nor for the people who are their customers or for commercial activity. In rural areas water supply may be more challenging due to the reduced yield of small water sources and wells drying up. However, the problems in the countryside are much smaller than those in urban areas. Still, any lengthening of a temporary interruption in water distribution, for example, causes significant harm.

| **Human impacts** | **I** | **II** | **III** | **IV** | **V** |
|---|---|---|---|---|---|
| Dead (No) | <= 5 | | | | |
| Injured (No) | | | | 151-600 | |
| Evacuated (No) | <= 50 | | | | |
| **Economic impacts** | | | | | |
| Material losses (MEUR) | | | 10-100 | | |
| Consequential loss (MEUR) | | 1-10 | | | |
| **Environmental impacts** | | | | | |
| Environment (sq km) | | 1-10 | | | |
| Duration | | < mo | | | |
| **Societal impacts** | | | | | |
| Critical infrastructure (No) | | 3-4 | | | |
| Duration | | 1 d - 6 d | | | |
| Vital functions (No) | 0-1 | | | | |
| Duration | | 1 d - 6 d | | | |

### *Predicted reliability*

Since extremely reliable long-term information exists on drinking water safety and drought as a phenomenon, the reliability of the assessment can be regarded as high. Nonetheless, society's increasing reliance on technology, the possibility of intentional interference and climate change make the evaluation process more difficult. As statutes and guidelines are being developed, attention is paid to water supply preparedness which, for its part, increases the reliability of the assessment.

| **Predicted reliability** | **Low** | **Average** | **High** |
|---|---|---|---|
| | | 2 | |

### *Overall estimate*

| **Risk assessment** | **Probability** | **Impact assessment** | **Risk score** |
|---|---|---|---|
| | 4 | 2 | **8.0** |

## 3.10 A large-scale winter storm followed by a long cold spell

### Background information

An ‘extreme weather event’ normally means weather events that recur a few times in a century. Such phenomena in Finland include, among other things, windstorms, thunderstorms, heat waves, cold spells, heavy rains and heavy snowfall. Often, in the vernacular, extreme events also imply such weather events which have significant consequences, even though they recur more frequently.

Climate change is known to alter the recurrence cycles of some weather phenomena such as the durations of heat waves and cold spells. However, the possible changes of small scale phenomena such as thunderstorms are not yet fully understood.

Even though the most extreme weather events such as ice storms are not recorded in Finland’s weather history, they are not impossible if the climatic conditions evolve and become more favourable to them. Freezing rain can cause problems, particularly, in electric power distribution and transport logistics.

Extreme weather events can be divided into rapid or slow onset events. Whereas the rapid onset events include severe wind gusts associated with thunderstorms, among others, sustained heat or cold waves represent the slow onset phenomena. Both types can have significant impacts on society.

### Risk description

*Windstorms*

Due to its impacts, a windstorm is one of the most intense weather events in Finland. A cyclonic storm is a large-scale weather event which can sustain several simultaneous weather hazards. The most important of these in the winter and the autumn involves strong winds. When the average wind speed equals or exceeds 21 m/s on the open sea, it classifies as a storm. On land areas weather damage is caused by gusts, especially when the wind speed briefly exceeds 20 m/s.

A storm has a serious impact on human safety, the economy and the environment alike. It is a wide-spread phenomenon and its direct impacts can be significant and, probably, sustained, especially at the local but also at the regional level. A storm is a major threat to the normal functioning of society.

Noteworthy strong storms include, among others, Mauri (22 Sep. 1982), Janika (15–16 Nov. 2001) and Tapani (26 Dec. 2011).

***Description of actions vis-à-vis the risk***

To facilitate preparedness the Finnish Meteorological Institute (FMI) provides tailored early warning reports to different actors in society. These early warning reports especially aim to describe the consequences of weather phenomena on the functioning of society and the emergency services. The FMI’s Weather and Safety Centre monitors weather events which can cause danger or harm and provides associated forecasts and warnings on a 24/7 basis. The Centre constantly monitors the development of weather and provides specified services to its customers. During dangerous weather events such as winter storms, the Centre is prepared to commit more resources to providing the special services required by the situation. On the basis of the FMI’s warnings rescue departments and network operators raise their preparedness as required, so as to be able to respond to the situations caused by weather events.

The robustness of the electric distribution grid can be improved by digging medium and high voltage cables underground, and by widening the power line routes. The reliability of telecommunication systems can be improved through standby power systems (diesel generators, battery systems) and by increasing the number of backup systems.

In accordance with the Electricity Market Act, by means of preparedness and appropriate planning electricity transmission network operators shall ensure that electricity distribution will continue without undue interruption, and recover to the normal level with minimal disruption even in the exceptional circumstances referred to in the Emergency Powers Act and in disruptive situations under normal circumstances. The network operator must draw up a contingency plan and participate, as required, in preparedness planning intended to safeguard the security of supply. The contingency plan must be updated no later than every two years.

During disruptions, in order to eliminate the faults and limit their impacts, the network operator must cooperate with other grid operators, rescue authorities, the police, municipal and road authorities as well as other social infrastructure network operators in their region. During disruptions, electricity transmission network operators must participate in compiling a situation picture from their area of operations, and relay the appropriate information to the authority responsible for the situation picture. The network operator must provide a dedicated communication link for inter-authority communication in the control room or other space from where the operator manages the disruption.

***Evaluating the likelihood of occurrence, impacts and reliability of the scenario***

The scenario involves a windstorm which passes through Finland from the northwest to the southeast. In this case, much like Storm Janika, the average wind speed at sea would be approximately 32 m/s, gusting up to 35–40 m/s on land. The strongest winds would occur south of the Kokkola-Savonlinna line. The storm is expected to rage in winter conditions resembling those during Storm Tapani at which time the ground was not frozen. In such circumstances trees are prone to falling, which results in widespread and continuous damage to forests.

A rapid cooling follows the storm, from a few degrees above zero down to approximately -15˚C. The cold spell can go on for weeks.

The impacts of a windstorm occurring in the winter can be more severe than those of one happening in another season if it involves a rapid rise of sea level in the Baltic Sea or a severe frost in the aftermath of the storm. In addition, crown snow-loads clinging to trees and subsequent strong winds can cause a lot of tree damage as well as interruptions in power distribution when trees fall on transmission lines.

Storm Gudrun knocked down in all 75 million $m^3$ of trees in southern Sweden in 2005. For purposes of comparison, Storm Tapani’s damage resulted in 3–4 million $m^3$ of forest.

Owing to climate change the ground frost period is becoming shorter which makes it easier for trees to fall during storms.

***Probability***

Finland experiences a major storm once in a decade, on average. Extremely destructive storms are estimated to occur a few times in a century. The probability of an extended cold spell following a strong storm is high (once every 10–100 years).

| Probability | Very low | Low | Average | High | Very high |
|---|---|---|---|---|---|
| | | | | 4 | |

***Risk impact***

Human impacts:

Critical infrastructure damage can cause health impacts; these include the injuries and fatalities directly resulting from trees falling and flying debris. The cold spell that follows the storm may have serious indirect impacts on human health.

Economic impacts:

The storm and the subsequent cold spell cause serious economic damage which is directed at energy supply (distribution of electricity and heat) and transport logistics. The indirect impacts are felt in ICT infrastructure. Have extensive impacts on commercial activity and individuals.

If the storm knocks down a significant number of trees, forest owners sustain financial losses, as storm-damaged trees do not necessarily fetch premium price, or the trees can be destroyed to the extent that they become worthless. Consequently, wood supply to the forestry industry becomes disrupted, because suddenly the wood market becomes flooded with a large number of trees; storage and keeping the wood fresh becomes a problem. If the fallen trees cannot be harvested in time before summer, secondary damage, i.e. insect pest damage, becomes a real possibility which, in the worst case, can result in widespread deforestation.

Section 281 of the Information Society Code (917/2014) obligates telecommunications operators to ensure that their activities will continue with minimal disruption even in the exceptional circumstances referred to in the Emergency Powers Act and in disruptive situations under normal circumstances. In FICORA's cooperative working group for disruptions, telecommunications and electric companies coordinate the supply of backup power to the critical nodes in communication networks. Telecommunications operators incur considerable costs from storm preparedness and storm damage repairs.

Environmental impacts:

The storm will cause extensive and long-lasting forest damage. It can also cause significant indirect environmental impacts (e.g. the release of harmful agents into nature).

Societal impacts:

A storm would have significant impacts on daily life because of, among other things, power outages and the ensuing heat and water distribution problems. The cold spell following the storm would have serious consequences, possibly requiring extensive evacuations.

| Human impacts | I | II | III | IV | V |
|---|---|---|---|---|---|
| Dead (No) | <= 5 | | | | |
| Injured (No) | | | 46-150 | | |
| Evacuated (No) | | | | 501-2,000 | |
| **Economic impacts** | | | | | |
| Material losses (MEUR) | | | | 100-500 | |
| Consequential loss (MEUR) | | | | 100-500 | |
| **Environmental impacts** | | | | | |
| Environment (sq km) | | | | | > 1,000 |
| Duration | < wk | | | | |
| **Societal impacts** | | | | | |
| Critical infrastructure (No) | | | | | 9-11 |
| Duration | | | | 2 wk - mo | |
| Vital functions (No) | | | 3-4 | | |
| Duration | | | | 2 wk - mo | |

***Predicted reliability***

| Predicted reliability | Low | Average | High |
|---|---|---|---|
| | | | 3 |

***Overall estimate***

| Risk assessment | Probability | Impact assessment | Risk score |
|---|---|---|---|
| | 4 | 3.45 | **13.8** |

## 3.11 A severe thunderstorm

### Risk description

In the vernacular, severe thunderstorms are sometimes referred to as storms. They, however, are two unrelated weather events. Heavy lighting, large hail, microbursts, heavy rain and tornadoes can accompany severe thunderstorms. While, typically, a violent thunderstorm will only cause geographically limited destruction compared to a cyclonic storm, it can wreak much more havoc locally. Violent thunderstorms can take people by surprise and, therefore, their impacts can be more severe because of poor preparedness.

Well-remembered severe thunderstorms include, among others, Unto (5 July 2002) and from the summer of 2010 Asta, Veera, Lahja, and Sylvi.

***Evaluating the likelihood of occurrence, impacts and reliability of the scenario***

The scenario includes a strong summertime thunderstorm striking the capital region with downbursts, large hail and a tornado. Momentary wind speeds in the microbursts can locally gust to 40 m/s. Giant hail, whose diameter can exceed 5 cm, fall from the thundercloud. The cloud creates a fairly strong, 100–200 metres wide tornado.

When the strong gusts hit urban areas they destroy structures and hurl loose debris around. The giant hail can cause significant damage to, for example, roofs and windows. The tornado can travel several kilometres and cause considerable destruction to buildings and critical infrastructure as well as loss of life. In 2010 violent thunderstorms Asta, Veera, Lahja and Sylvi destroyed in all 8.1m$^3$ of trees and insurance companies paid out in all approximately EUR 80 million in compensation. The corresponding compensations for Storms Hannu and Tapani were approximately EUR 102.5 million.

The effects of climate change on thunderstorm intensity or frequency is still not known that well.

### *Probability*

The strongest thunderstorms – supercells – occur in Finland a few times every year on average. Only 20–30% of supercells spawn tornadoes.

The probability of the phenomena occurring in the capital region, as described in the scenario, is low (once every 500 years).

| Probability | Very low | Low | Average | High | Very high |
|---|---|---|---|---|---|
| | | 2 | | | |

### *Risk impact*

The event can develop extremely rapidly. This makes preparedness a challenge and the impacts catastrophic.

<u>Human impacts:</u>

When a tornado hits a densely populated area, in the worst case scenario scores can perish and hundreds sustain injuries. Damage to critical infrastructure can cause health impacts, including deaths and direct injuries resulting from trees falling and debris flying around.

<u>Economic impacts:</u>

Hundreds if not thousands of dwellings become uninhabitable and the reconstruction can take years. Damage to critical infrastructure causes considerable direct and indirect economic impacts which can be long-lasting.

If a large number of trees fall in the storm, forest owners sustain financial losses (storm-damaged trees do not necessarily fetch premium price, or the trees can be destroyed to the extent that they become worthless).

<u>Environmental impacts:</u>

A severe thunderstorm can also cause significant indirect environmental impacts (e.g. a release of dangerous substances into the environment).

<u>Societal impacts:</u>

The Thunderstorm damage will cause prolonged instability in the viability of society because of damaged infrastructure.

| Human impacts | I | II | III | IV | V |
|---|---|---|---|---|---|
| Dead (No) | | | 16-50 | | |
| Injured (No) | | | 46-150 | | |
| Evacuated (No) | | | | | > 2,000 |
| **Economic impacts** | | | | | |
| Material losses (MEUR) | | | | | > 500 |
| Consequential loss (MEUR) | | | | 100-500 | |
| **Environmental impacts** | | | | | |
| Environment (sq km) | | | | 100-1,000 | |
| Duration | < wk | | | | |
| **Societal impacts** | | | | | |
| Critical infrastructure (No) | | | | | 9-11 |
| Duration | | | | 2 wk - mo | |
| Vital functions (No) | | | 3-4 | | |
| Duration | | | | | over mo |

### *Predicted reliability*

Predicted reliability is average. Owing to past weather events in the United States there is an abundance of information on the effects of supercells and strong tornadoes that have occurred in urban areas. As for the capital area, for example, the likelihood is very difficult to estimate. In the weather history of Finland there have been tornadoes in conjunction with supercells, but when it comes to strong tornadoes there have been fewer than ten. It is possible that a strong tornado could hit the capital city area, but the likelihood is negligible.

| Predicted reliability | Low | Average | High |
|---|---|---|---|
| | | 2 | |

### *Overall estimate*

| Risk assessment | Probability | Impact assessment | Risk score |
|---|---|---|---|
| | 2 | 3.82 | **7.6** |

## 3.12 A terrorist act or terrorism targeting Finland

### *Background information*

A terrorist act or terrorism targeting Finland or Finns can, on the one hand, constitute an act of violence perpetrated by a terrorist organisation or, on the other hand, a terrorist act committed by individuals or small groups. A terrorist act or terrorism targeting Finland also includes strikes against Finland's embassies or foreign missions.

An act of organised terrorism in Finland causes considerable ramifications. The strike can target Finland's political system, public infrastructure such as the water supply system, energy production and its distribution network, public transport or its control systems, financial and payment systems, the interests of other countries established in Finland, international events or the general public in an indiscriminate manner. Finns abroad can also become victims of a terrorist attack. All European countries face the threat of individual extremists and/or small terrorist groups which are organised to some degree.

The threat of terrorism has significantly risen in many countries. This stems from quite a large number of radicalised people travelling to conflict areas, and from increasingly intensified radicalisation in their home countries. As the number of people returning from conflicts, after having participated in radical action, increases, the potential for concrete and violent radical action grows. For its part, the European countries' reaction against the people who left and joined the conflict only exacerbates the threat; in some cases it may provoke a violent reaction back in the people's home countries.

***Risk description***

The scenario includes the detonation of a radiation source with conventional explosives, i.e. a 'dirty bomb', which, in addition to the explosive effect, causes a radiation hazard. The scenario accommodates a terrorist organisation, a small group or an individual as the perpetrator. The severity of the radiation hazard depends on the quality and quantity of the radioactive matter used and the explosive effect of the charge.

The point of detonation and its immediate surroundings, at the radius of 300–400 metres, become severely contaminated. In addition, the area may contain extremely small, powerfully radiating fragments which can cause difficult-to-treat radiation burns on the skin if handled even for a few minutes. Particular attention must be paid to the radiation safety of the emergency personnel participating in the rescue effort and in treating the victims of the detonation.

The wind carries the radioactive emission generated by the detonation and it eventually falls on all surfaces, causing radioactive fallout in a few square kilometres. The contamination process takes less than half an hour even when winds are light. Hence, there is not enough time for civil protection measures before the area becomes contaminated.

When it comes to the vicinity of ground zero, people will have to be immediately evacuated from the worst contaminated area up to 1–2 kilometres downwind. The evacuated area will be cordoned off at which time all functions inside the area are terminated.

The people within the fallout range of the explosion, especially those who were outdoors, must be measured for radiation to establish their level of contamination. Depending on the location, the number of people can rise to tens of thousands. In addition, radiation measurements from the entire affected area have to be carried out. This includes, among other things, spaces indoors and vehicles. The need to carry out successive measurements can last a long time.

It is expensive to decontaminate the affected environment, and can even take years. The volume of radioactive waste accrued in the decontamination effort is sizeable. In addition, the radiation safety of the personnel participating in the effort must be addressed.

Along with the area affected, considerable psychological and economic knock-on effects are also highly likely in uncontaminated areas.

***Description of actions vis-à-vis the risk***

In addition to their own information gathering the counter-terrorist authorities obtain information from their international contacts which makes it possible to provide up-to-date assessments regarding the terrorist threat. On the basis of analysed information the authorities can launch pre-emptive action to mitigate and repel any potential threat.

Alongside international cooperation, well-functioning and active cooperation between different national authorities and actors is of the essence. Such cooperation plays an important role in the prevention of religious radicalisation. The National Cooperation Network for the Prevention of Violent Extremism, for its part, seeks to prevent the problems associated with religious radicalisation, as well. It aims to ensure cooperation between the authorities that the prevention requires, promote dialogue with the civil society and guarantee the implementation of national prevention of violent extremism. This cooperation seeks open interaction between different actors as well as the dissemination of lessons learned and best practices. Teachers, social workers, health care personnel and youth workers, aided by the expert assistance of the police, play a crucial role in identifying violent extremism and in early intervention.

Also the *National Counter-Terrorism Strategy* proposes strategic measures and mentions responsible authorities who, for their part, aim at preventing violent radicalisation. The Strategy mentions the prevention of violent radicalisation through delivering an effective integration policy. The key to this measure is support for integration. In addition, it is proposed that the prevention of violent radicalisation and terrorist recruitment be bolstered by combating social exclusion and by supporting employment opportunities.

Radiation safety efforts aim at keeping radiation sources safe at the places where they are used in Finland. The safety of radiation sources, especially highly active ones, must be safeguarded even after they have been decommissioned, so that they do not end up in the wrong hands.

Border control safeguards Finland from illegally imported radiation sources. Still, once every year, on average, unclaimed radiation sources are found in Finland. Most often they are discovered among scrap metal.

It is of the essence to prevent, through security arrangements and radiation measuring, for example the detonation of a dirty bomb during a mass event.

***Evaluating the likelihood of occurrence, impacts and reliability of the scenario***

***Probability***

Finland is not the primary target of terrorist organisations. The threat of organised terrorism aimed directly at Finland or its population is low. However, the overall threat of terrorism in the West has risen, its character has become more complex and it is increasingly difficult to evaluate. The threat of any significant and intentional contamination of the Finnish environment with radioactive substances is low.

| Probability | Very low | Low | Average | High | Very high |
|---|---|---|---|---|---|
| | | 2 | | | |

***Risk impact***

The impacts of a terrorist act in Finland would be serious or extremely serious, depending on the target and the number of fatalities or injured persons, and whether the strike included radioactive substances. Moreover, should the strike target some other country's interests inside Finland, or an international event, it would also include foreign policy implications. An act of terrorism against civil aviation would have wide-ranging economic impacts.

| Human impacts | I | II | III | IV | V |
|---|---|---|---|---|---|
| Dead (No) | | | 16-50 | | |
| Injured (No) | | | | | > 600 |
| Evacuated (No) | | | | | > 2,000 |
| **Economic impacts** | | | | | |
| Material losses (MEUR) | | | 10-100 | | |
| Consequential loss (MEUR) | | | 10-100 | | |
| **Environmental impacts** | | | | | |
| Environment (sq km) | | 1-10 | | | |
| Duration | | | | | > 1 yr |
| **Societal impacts** | | | | | |
| Critical infrastructure (No) | | 3-4 | | | |
| Duration | | | | | > mo |
| Vital functions (No) | | | 3-4 | | |
| Duration | | | | | > mo |

***Predicted reliability***

The assessment is based on an overall analysis of terrorist threats against different European countries as well as a more specific analysis based on national and international intelligence information. Even if the evaluation of the probability and the impact is fairly reliable, the terrorist threat incorporates many uncertain factors. It is somewhat difficult to forecast and assess the risk.

As far as we know, so far no dirty bomb detonations have occurred. Radioactive substances have been inadvertently released into the environment, such as in Goiânia, Brazil in 1987, where two individuals opened a highly radioactive, abandoned caesium radiotherapy source. The capsule contained a powderlike substance which was inadvertently spread by the people into the environment. Approximately 110,000 people were measured in Goiânia for radioactivity, about 250 of whom were found to be contaminated. Fifty people were hospitalised, a third of whom needed intensive care. Four persons died within a month from the event. In the cleanup operation several houses were demolished and topsoil had to be removed. In all, 3,000 $m^3$ of radioactive waste was collected; it took 10 years to dispose of the waste.

| Predicted reliability | Low | Average | High |
|---|---|---|---|
| | | 2 | |

***Overall estimate***

| Risk assessment | Probability | Impact assessment | Risk score |
|---|---|---|---|
| | 2 | 3.73 | **7.5** |

## 3.13 A serious act of targeted violence

***Background information***

*Targeted violence* normally refers to such acts of violence where the perpetrators pre-select their targets.[15]

Targeted violence includes, among others:

- Assassinations,
- Workplace violence and domestic violence,
- Stalking,
- School violence – school shootings,
- Examples are: the attacks by Anders Breivik in Norway; the plan to strike Helsinki University; the shooting at Sello shopping centre; and the suicide bombing at Myyrmanni shopping centre.

The pre-selected target normally involves one or more people, or an institution. The deeds constitute deliberate homicide rather than impulsive acts; **they are definitely not accidents**. Shootings are rarely preceded by threats (threats made against schools). The perpetrator typically informs one of his peer groups of his plan.

No precise 'profile' of the perpetrator that would be helpful exists. Prior to the deed other people are aware of their thoughts and/or ideas. In most cases the perpetrators tell/inform someone of their plans. However, this is not always the case. Their behaviour or conduct leads other people to worry about them or is an indication of a cry for help. Many of them are known to have had problems in dealing with loss or failure and many have suffered from depression, tried to commit suicide or wrestled with mental problems. Prior to their act several perpetrators have felt bullied, harassed and offended.

Perpetrators have access to weapons and are experienced in gun handling. Normally they painstakingly plan the deed and spend much time on Internet sites that glorify violence and mass murders. They have often been interested in violent extremism. As such, these ideologies (misanthropy, Nazism, far left ideologies, etc.) do not seem to have any other bearing on the perpetrators other than to justify the violent act in their minds. Then again, political (e.g. environmentalism) or religious (e.g. murdering the cartoonists depicting the Prophet Muhammad) motivations have clear connections with the acts of terror committed by individuals or small groups.

Once their deeds are planned the perpetrators are extremely motivated to carry it out. The killing will continue until either the plan has been completed or the killer is stopped. On average, the situation goes on for 20 minutes and every additional minute in the active phase can translate into more casualties.

Large media coverage may trigger a 'copycat-phenomenon' for several weeks. Notoriety and 'going down in history' are also prevalent in the perpetrators' minds.

The perpetrators normally act alone or in small groups. It is extremely difficult and challenging to prevent the acts of 'lone wolves'. Typically, the location is personally relevant to the perpetrator. Most often these acts are committed in schools and educational institutions (Jokela, Kauhajoki, Orivesi and Helsinki University) as well as shopping centres in Finland (Sello and Myyrmanni). This *modus operandi* is also employed in acts of terrorism such as the strikes at a hotel in Mumbai and against a

---

[15] Fein, R. & Vossekuil, B. (1999). Assassination in the United States: an operational study of recent assassins, attackers and near-lethal approaches. Journal of Forensic Sciences, 44:2, 321-333.

university in Kenya as well as the deeds in Paris and Copenhagen. The only differences are the perpetrators' ulterior motives for the deeds and, possibly, better weaponry.

The phenomenon of targeted violence at educational institutions was seen as early as 1966 in the United States in a shooting at the University of Texas at Austin. In the United States these acts occur repeatedly at different venues such as schools, movie theatres, workplaces and churches; more than 50 cases have been school shootings. These shootings alone stand for between 1 and 33 fatalities per instance.

In Canada there have been at least eight such cases; four in Germany from 2002–2009; three in Finland from 2007–2014 (plus one instance in 1989). In addition there was a plan to strike the University of Helsinki; and there were two cases in Israel (in 1974 and 2008).

***Risk description***

Following the school shootings in Finland, the phenomenon is here to stay. Currently, it is a constantly present threat. The police are repeatedly finding people who are contemplating mass murder; they are either in the early stages of planning it or working out their violent fantasies and making tentative plans. The associated actions involve the glorification of prior deeds as well as obtaining different kinds of equipment and gear.

The modi operandi, in Finland and around the world, incorporate attempts to incinerate or blow up the target while the shooting or other killing continues. It is likely that, at some point in time, somebody will succeed in committing a serious act of violence, resulting in a large number of victims.

From the perspective of society, irrespective of the number of victims, such an act would seriously impact people's sense of security and political decision-making as well as the confidence of citizens in the authorities. Expensive safety measures would have to be incorporated at schools to improve their security. This, however, would contradict the principle of open learning environments.

***Description of actions vis-à-vis the risk***

Prevention and early intervention are the means by which it is possible to deter these kinds of events. Following the school shootings in Finland, over 155 measures have been launched, many of which are continuously being implemented. A special follow-up report for the Internal Security Programme has been published on this topic.

A national security guide for the education sector has been drawn up. The police and the rescue services have designated liaisons to all schools, in addition to which the personnel of the Finnish Police and the Border Guard are trained in the modernised tactical setting. The educational sector together with the health care and social welfare sector and the police develop threat assessment and risk management. Also firearms legislation has been tightened. The Act on the Status and Rights of Patients has been amended. The purpose of the amendments is to make it possible, on one's own initiative, to provide information associated with the protection of life and health to the police in order to facilitate the making of a threat assessment. In other words, to expedite the flow of information between the health care and social welfare authorities and the police, among others.

### *Evaluating the likelihood of occurrence, impacts and reliability of the scenario*

### *Probability*

The police are constantly aware of persons who are likely contemplating or about to start planning in detail school-shooting type mass murder. It is certain that the police are not aware of all such cases.

| Probability | Very low | Low | Average | High | Very high |
|---|---|---|---|---|---|
| | | | | 4 | |

### *Risk impact*

| Human impacts | I | II | III | IV | V |
|---|---|---|---|---|---|
| Dead (No) | | | 16-50 | | |
| Injured (No) | | | 46-150 | | |
| Evacuated (No) | | 51-200 | | | |
| **Economic impacts** | | | | | |
| Material losses (MEUR) | < 1 | | | | |
| Consequential loss (MEUR) | < 1 | | | | |
| **Environmental impacts** | | | | | |
| Environment (sq km) | < 1 | | | | |
| Duration | < wk | | | | |
| **Societal impacts** | | | | | |
| Critical infrastructure (No) | 0-2 | | | | |
| Duration | < d | | | | |
| Vital functions (No) | | 2-3 | | | |
| Duration | | 1 d - 6 d | | | |

A massive strike (cf. Breivik in Norway) would seriously impact society. School killings and corresponding extensive acts of violence have resulted in widespread psychological harm and the need for psychosocial support. These psychosocial impacts should be taken into consideration when doing risk assessment.

### *Predicted reliability*

According to present police information and measures, as well as relying on experience, the assessment can be considered reliable. On a 1–3 scale the reliability is high (3).

| Predicted reliability | Low | Average | High |
|---|---|---|---|
| | | | 3 |

### *Overall estimate*

| Risk assessment | Probability | Impact assessment | Risk score |
|---|---|---|---|
| | 4 | 1.64 | **6.6** |

## 3.14 Violent, large-scale civil disturbances

### *Background information*

Every year Europe experiences violent, large-scale civil disturbances, which can go on for days. This kind of rioting is often triggered by a large demonstration or is an outlet for dissatisfaction and a release of social tension in a given area. In recent years such disturbances have been witnessed in Sweden, Denmark, Germany, France and England, among others.

It is entirely possible that large-scale and violent disturbances, beyond the control of the police, can occur in Finland as well. They will impact society's functions and concretely and seriously degrade the security of citizens. At the same time the disturbances will tarnish Finland's external image. The factors that increase the risk of disturbances include the types of social problems and experiences of inequality that affect people's everyday life, increasing social exclusion, the growing significance of extremism, the effect of the social media and the increasingly tense international situation.

### *Risk description*

Large, violent disturbances originate from a large-scale riot criticising social ills. Radical activists, domestic and foreign alike, participate in the uprising and they markedly spur the onset of rioting through their agitation. The acts of vandalism committed by a small number of people (breaking windows, damaging vehicles) and the violence against the police (throwing bottles and stones) impact the dynamics of the situation in such a manner that more and more demonstrators join the illegal action. When the police respond by using force, the situation escalates into widespread rioting and, as a result, the police lose control of the situation. Shop windows are broken, vehicles are set alight and barricades are erected on the streets to impede police action. Several demonstrators and police officers are hurt in scuffles.

The national and international media closely follow the events. Foreign reporters may wonder what has happened to the otherwise even-tempered and stable Finnish society when people vent their frustrations violently in ways not seen up to. Material damage rises to millions of euros.

The disturbance begins late in the evening at a rented housing estate where the majority of people are immigrants. Scores of local youths vent their frustration by damaging property and by assaulting passers-by. When the police arrive, the youths are increasingly provoked and direct their violence towards the police by hurling stones and bottles at them. The rioters impede the actions of the police by erecting barricades on the streets, setting some of them on fire. Nearby shop windows are broken and several cars are set alight. Social media is awash with requests to join the riot, and more and more young people arrive at the scene. When the news spreads, disturbances start in other communities and cities as well. The riot goes on all night only to start again the following evening. Many demonstrators and police officers are injured in the clashes.

### *Description of actions vis-à-vis the risk*

Long-term intersectoral measures aiming at preventing violent extremism and radicalisation decrease the likelihood of disturbances.

The police can prevent such situations by using threat assessments made on analysed police intelligence. It is possible to prevent and limit the violence beforehand through dialogue with the event's organisers, and by agreeing on the rules and the 'red lines.'

Sufficient and visible police presence prepared for crowd control may reduce the risk of disturbances. Once started, the disturbance and damages can be limited through crowd control. However, it is not possible to entirely avert or put a stop to the unrest through police action.

### *Evaluating the likelihood of occurrence, impacts and reliability of the scenario*

### *Probability*

Violent, large-scale civil disturbances have flared up in Europe and in Nordic countries close to Finland. However, since we do not have a history or culture of violent, large-scale civil disturbances, the risk is lower compared to many other European countries. In the European context Finnish society does not have much inclination for rioting.

| Probability | Very low | Low | Average | High | Very high |
|---|---|---|---|---|---|
| | | | 3 | | |

### Risk impact

Human impacts:

The citizens' sense of security degrades both locally and nationwide. The consensus-seeking image of Finnish society is shattered.

Economic impacts:

Hundreds of thousands/millions of euros worth of damage from:

- Damaged buildings
- Damaged vehicles and other personal property
- Temporary interruptions in the local economy, and
- Post-event assessments

Societal impacts:

Strong public criticism and a loss of confidence in politicians and the authorities. Finland's public image abroad is tarnished. Politically extremist movements become active.

Environmental impacts:

The environmental impact, in terms of area and duration, remains small.

| Human impacts | I | II | III | IV | V |
|---|---|---|---|---|---|
| Dead (No) | | | | 5-200 | |
| Injured (No) | | | 46-150 | | |
| Evacuated (No) | | 51-200 | | | |
| **Economic impacts** | | | | | |
| Material losses (MEUR) | | 1-10 | | | |
| Consequential loss (MEUR) | | 1-10 | | | |
| **Environmental impacts** | | | | | |
| Environment (sq km) | <1 | | | | |
| Duration | < wk | | | | |
| **Societal impacts** | | | | | |
| Critical infrastructure (No) | 0-2 | | | | |
| Duration | < d | | | | |
| Vital functions (No) | | 2-3 | | | |
| Duration | | 1 d - 6 d | | | |

***Predicted reliability***

According to present police information and measures, as well as relying on experience, the assessment can be considered reliable. On a 1–3 scale the reliability is high (3).

| Predicted reliability | Low | Average | High |
|---|---|---|---|
| | | | 3 |

***Overall estimate***

| Risk assessment | Probability | Impact assessment | Risk score |
|---|---|---|---|
| | 3 | 1.91 | **5.7** |

## 3.15 A mass influx of migrants

***Background information***

In 2015 the number of asylum seekers skyrocketed and, according to estimates, approximately 30,000–35,000 asylum seekers will have arrived in Finland by the end of this year. Most of them come from Iraq, Afghanistan and Somalia.

The new situation particularly reflects the serious conflicts and social crises in Africa and the Middle East. The numbers of asylum seekers have risen all over Europe; it is wholly about protracted migration. For example, approximately 81,000 asylum seekers arrived in Sweden in 2014. Especially the Finnish Red Cross has assisted in the reception of asylum seekers at the now many more locations in Finland, and the personnel resources of the Finnish Immigration Service and the police have been increased to guarantee decisions on asylum without undue delay. It must also be possible to efficiently remove from the country those who have been denied asylum.

The ongoing global refugee crisis is the largest since the Second World War. Also in Finland the number of asylum seekers has rapidly risen since the summer of 2015, having already exceeded the threshold of a ‘mass influx of migrants, i.e. 20,000 applicants. Finland has no previous experience of such a mass influx.

***Risk description***

A mass influx of migrants can result from wars, natural disasters or accidents. In such a situation there is always the risk of not being able to register and receive migrants in a controlled manner, and that the application process cannot be completed within a reasonable time frame. The risk to the economy grows if the phase following the decision on asylum – placement of residence permit holders in municipalities and removal from the country of those whose alyssum application was refused – cannot be carried out in an efficient manner. In a mass influx situation the regional authorities' plans will be taken into use. Shortcomings in their contingency plans and cooperation models may increase the risk.

Migration turns into a mass influx when the number of migrants exceeds 20,000 persons in a very short period of time, and when the preconditions for their entry or registering is not possible under normal procedures. The situation demands the establishment of new registration centres and reception centres in the areas most affected by migration, and securing the financial and personnel resources for this purpose. The Government may also grant temporary protection to the migrants, as required.

The risk may arise from an individual cause or from several simultaneously influencing factors. Such factors may include a serious decline in border management and intentional or inadvertent interference in ICT systems, such as cybercrime or sustained power outages in electricity distribution. Risk is also increased by a shortage of resources in the early stages of immigration, such as the number of authorities responsible for registration, asylum decisions and removals, or the resources available to the regional authorities. A mass influx of migrants can increase the risk of infectious diseases spreading among the population. In order to reduce this risk, the authorities must ensure that the migrants have proper immunisation coverage, and carry out appropriate screening for infectious diseases.

***Description of actions vis-à-vis the risk***

Preparedness includes establishing registration and reception centres, organising other reception arrangements as well as comprehensive national and regional cooperation between the authorities. When necessary, temporary protection may be granted on national grounds or pursuant to an EU Council Directive.

During a mass influx the border management system sees to it that the authorities are able to appropriately manage the migrants. Also the police intensify the monitoring of immigration in a mass influx situation. The aim is to establish the identity of all asylum seekers, to promptly collect their biometric information and to efficiently secure reception services and the processing of asylum applications as well as carry out removals, even in exceptional circumstances.

Together with the municipalities the Centres for Economic Development, Transport and the Environment sustain the contingency plans for establishing registration and reception centres when a massive displacement of people occurs. Together with the municipalities, and possibly with other actors, the Centres chart suitable premises and sign letters of intent with municipalities to house up to 100,000 asylum seekers. Regional contingency plans also take into account the role of trained volunteers and organisations. The Finnish Immigration Service coordinates the establishment of registration and reception centres, nationwide and regionally, and sets up a situation centre to compile national situation picture and to coordinate the accommodation services.

The Centres approximate the needed transportation resources in different threat situations and prepare the required reservations and plans in their respective areas.

Under the act on the reception of asylum seekers the Finnish Immigration Service is responsible for matters pertaining to the establishment and operation of registration and reception centres. It is the duty of the Service to sign the appropriate contracts with municipalities, communities and private actors.

A registration centre is set up for the urgent, initial reception phase. The centre only provides short-term accommodation for a few days, which is why the applicant is given supplies (e.g. food, clothing and personal hygiene items) for the immediate need. No reception allowance is paid. This support is provided up to the point when applicants are transferred to the reception centre for the asylum application processing period or to another accommodation, or until they leave voluntarily or are removed from the country.

The reception arrangements for asylum seekers, consisting of accommodation, meals, reception and spending allowances, health care and social welfare services as well as employment and education services, are launched with minimal delay following their arrival at the reception centre.

The Finnish Immigration Service agrees on the aforementioned topics with the operator of the reception centre and, during an urgent crisis, with the Finnish Red Cross.

The 2001 EU Council Directive lays down minimum standards for giving temporary protection in the event of a mass influx of displaced persons who cannot safely return to their country of origin because of the prevailing situation. The goal of the Directive is to promote *a balance of efforts between Member States in receiving such persons and bearing the consequences thereof*. The Directive, however, has not been applied in practice.

The EU's Asylum, Migration and Integration Fund (AMIF) provides emergency financial assistance to the Member States. An 'emergency situation' means a situation resulting from *heavy migratory pressure in one or more Member States characterised by a large and disproportionate inflow of third-country nationals*. In addition, emergency situations include circumstances during which temporary protection mechanisms are implemented and those caused by *heavy migratory pressure in third countries*. Because of the sudden mass influx of migrants, on 15 October 2015 Finland applied for emergency assistance to address the costs arising from registration and reception arrangements.

***Evaluating the likelihood of occurrence, impacts and reliability of the scenario***

***Probability***

Prior to the summer of 2015 Finland had no experience with a mass influx of migrants. The global migration to the Mediterranean and European countries shows that Finland, too, is the target of refugee flows. Therefore, the mass influx scenario is completely plausible. Because of our northern geographical position the probability of such an event is estimated as average.

| Probability | Very low | Low | Average | High | Very high |
|---|---|---|---|---|---|
| | | | 3 | | |

**Risk impact**

Human impacts:

The impacts can be evaluated on the grounds of the nature, scope and regional focus of the situation. The immediate impacts involve the requirement to feed and house people, and to respond to their health care and social welfare needs. The reception centres' private health care service requirements have been calculated on the basis of 40,000 immigrants. Local differences in health care and social welfare resources are, however, great. The sufficient number of interpreters for health care and social welfare services may, at times, become a bottleneck at reception centre localities. Special attention must be paid to safeguarding the reception and the interests of unaccompanied minors who have arrived in Finland. When it comes to children and adolescents, their early childhood education and care as well as participation in basic education must be secured. These needs will be met in accordance with the plans, resources and available services of the Finnish Immigration Service and local and regional actors. Public information and communication as well as all-round interaction between the authorities, NGOs and residents in municipalities can promote the dissemination of correct and truthful information to immigrants and the local population alike.

Economic impacts:

This situation can cause significant economic impacts to society, arising from the needs of the authorities and the provision of appropriate accommodation for immigrants (reception and registration centres, other means of accommodation) as well as from services and measures delivered during the active phase of the situation (accommodation, food services, allowances). If immigrants choose to stay in Finland after they receive residence permits, Finland will incur considerable costs from services provided during the integration of immigrants, such as integration and language education, in the coming years.

The costs of one asylum seeker at a reception centre total approximately EUR 40 per day, premises and personnel expenses included. On average, asylum application processing takes 170 days. However, in a mass influx situation the processing times are probably longer. Calculating the costs for 30,000 asylum seekers for 170 days, the total exceeds EUR 200 million. In addition to this, the state incurs extra administrative costs from having to employ more personnel for government agencies due to the growing number of customers. The costs incurred from a mass influx of migrants are included in the column ‘material losses’ in the impact assessment table.

Environmental impacts:

The impacts can be evaluated on the grounds of the nature, scope and regional focus of the situation. New registration and reception centres can also generate impacts on the immediate environment, such as increased traffic volumes (transportation of immigrants) and waste management arrangements.

Societal impacts:

This situation may degrade the citizens’ sense of security and the security of society as well as foment negative attitudes towards the immigrant population. It is also possible that international criminal organisations and religious extremists will try to take advantage of the new situation. The confidence of the citizens in the authorities and their abilities to manage the situation may decline due to insufficient personnel and other resources, among other things. Moreover, disorder, violence and radicalisation may also increase in society. The risk may also resonate beyond our borders and at international locations.

| Human impacts | I | II | III | IV | V |
|---|---|---|---|---|---|
| Dead (No) | <= 5 | | | | |
| Injured (No) | <= 15 | | | | |
| Evacuated (No) | <= 50 | | | | |
| **Economic impacts** | | | | | |
| Material losses (MEUR) | | | | | >500 |
| Consequential loss (MEUR) | < 1 | | | | |
| **Environmental impacts** | | | | | |
| Environment (sq km) | < 1 | | | | |
| Duration | | | | | > 1 yr |
| **Societal impacts** | | | | | |
| Critical infrastructure (No) | 0-2 | | | | |
| Duration | | | | | over mo |
| Vital functions (No) | | | | | 7 |
| Duration | | | | | over mo |

### *Predicted reliability*

While Finland has no previous experience of a mass influx resembling a massive displacement of people, the number of asylum seekers arriving in Europe alone proves that Finland is not only impacted by crises happening in its neighbourhood, but that international crises also resonate inside Finland.

| Predicted reliability | Low | Average | High |
|---|---|---|---|
| | | 2 | |

### *Overall estimate*

| Risk assessment | Probability | Impact assessment | Risk score |
|---|---|---|---|
| | 3 | 2.82 | **8.5** |

# 4 Summary

The goal of this first National Risk Assessment is to merge and compile all nationally critical risks to Finnish society. The objective of the project was to chart the risks as well as their impacts and probabilities. While the focus of the work was especially on risks affecting the civil protection authorities, also other events having wide-ranging impacts on society were taken into consideration as far as possible.

It is the goal of Finnish society to comprehensively prepare for significant events affecting society and serious regional occurrences. It is elemental to create the kinds of general capabilities which can be utilised in many dissimilar situations.

The National Risk Assessment divides risks into two categories: significant events affecting society and serious regional occurrences. These two categories were addressed in their own manner in the Assessment. The biggest difference is that where significant events affecting society were, for the most part, evaluated on the grounds of their impacts, serious regional occurrences were assessed from the perspective of their *probability and* impacts.

This risk assessment evaluates the impacts of occurrences between one another in four dimensions. Figure 6 illustrates the impact assessments of significant events affecting society. The assessments are not based on any precise numerical values. Therefore, figure 6 is only descriptive. The impact assessment addresses the events for four impacts: human, economic, societal and environmental ones; the farther away from the centre on the axis, the more serious the consequences from the perspective of the particular impact.

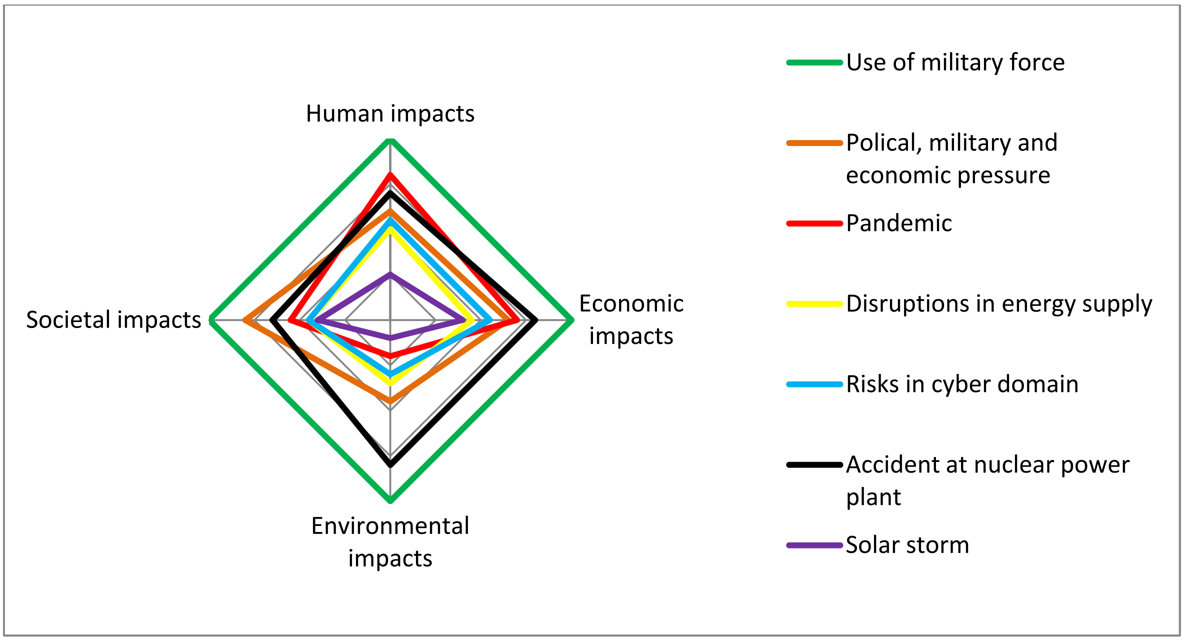


Figure 6. Descriptive correlations between significant events affecting society.

Preparations must be made for all events that affect society in a significant manner. The most notable differences involve the occurrence's degree of intentionality. The use of military force as well as political, military and economic pressure are foreign and security policy phenomena which are intended to generate a large impact on society and which do not normally arise all of a sudden. Disruptions in energy supply, risks in the cyber domain and an accident at a nuclear power plant can be the results of intentional or inadvertent factors or the forces of nature. Hence, they can occur without warning. A pandemic spreads relatively rapidly, but not entirely unexpectedly, and stopping its advance is difficult. Solar storms are caused by the forces of nature; they can happen relatively suddenly and it is impossible to forecast them with any degree of accuracy.

It would be inappropriate to place significant events affecting society together in the same risk matrix with serious regional occurrences. This is because their impacts are so dissimilar in extent. The main problem would be how to gauge their impact assessments in relation to serious regional occurrences. Predicted reliability evaluation is also quite challenging because there is simply not enough historical data available for probability calculations.

Serious regional occurrences are compiled and shown in the risk matrix in figure 7. Serious regional occurrences include historical data which makes it easier to much better approximate their likelihood and impacts compared to the significant events affecting society. The number in the parentheses indicates the reliability of the estimate; the numerical value 2 stands for average reliability, and the number 3 means high reliability.

When assessed by their impacts, four types of events range between categories III and IV: a large-scale winter storm with a long cold spell, a maritime accident, an act of terrorism where a radiation source is detonated and a severe thunderstorm. Whereas the two first represent average and high probabilities, the likelihood of terrorism and a severe thunderstorm remain low. An extensive windstorm happening in the winter represents the biggest risk because of its high probability, widespread extent and serious impacts.

When assessed by their impacts, six types of events range between categories II and III. Of these, average probability types are a mass influx of immigrants during a massive displacement of people, a major building fire at critical infrastructure, several simultaneously occurring forest fires, rapid flooding in or around a population centre as well as a serious chemical or explosive accident at an industrial installation handling dangerous substances. The estimated probability of a major aviation accident is low.

When assessed by their impacts, six types of events range between categories I and II: a major rail transport accident, large-scale civil disturbances, serious targeted violence, a major road traffic accident as well as a long, sustained disruption in the water supply. Whereas the two first represent average probabilities, the probability of the three remaining occurring is high.

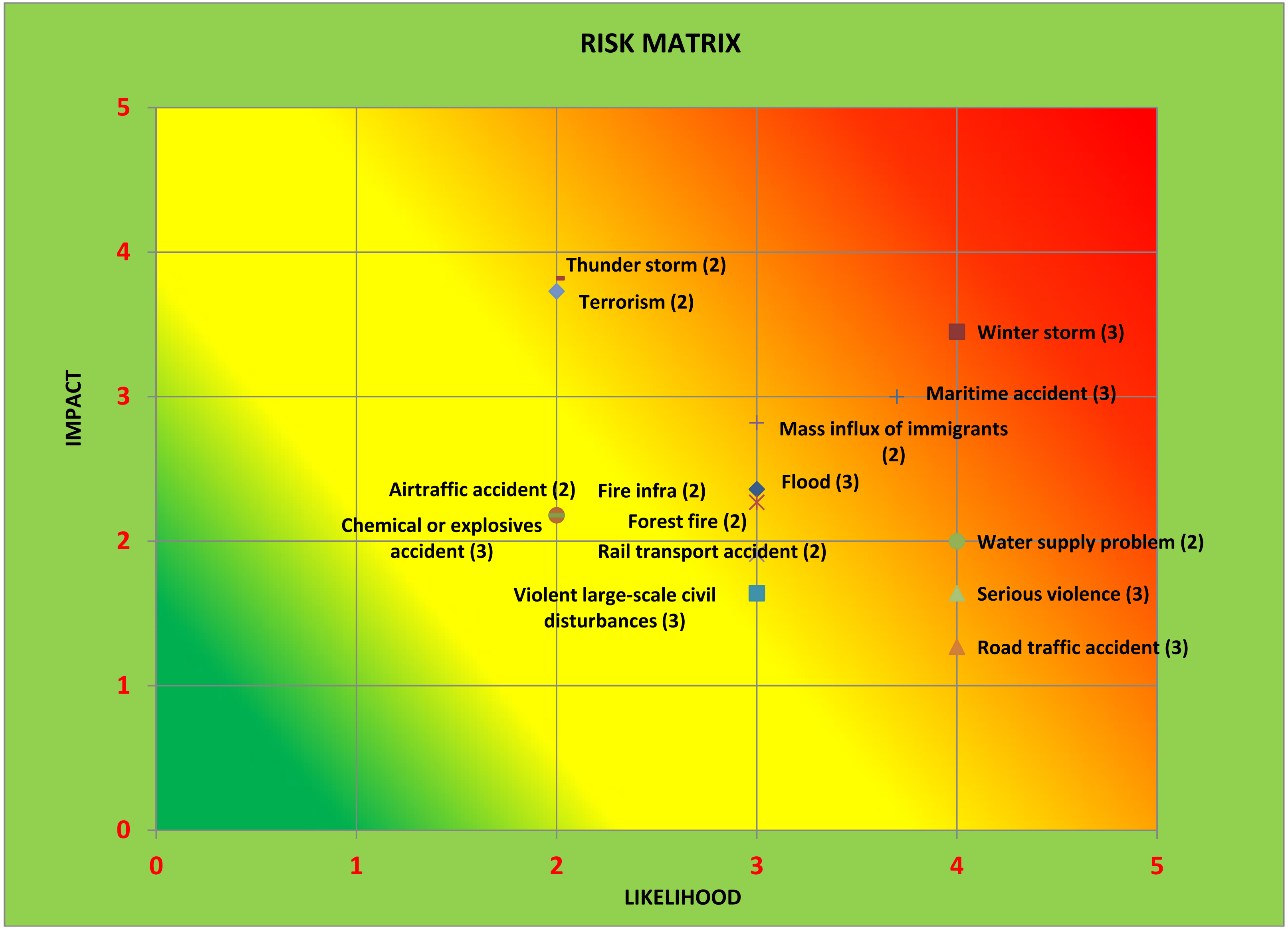


Figure 7: Serious regional accidents shown in a risk matrix

**Ministry of the Interior** PO Box 26,
FI-00023 Government, Finland
**www.intermin.fi**

MINISTRY
OF THE INTERIOR
FINLAND