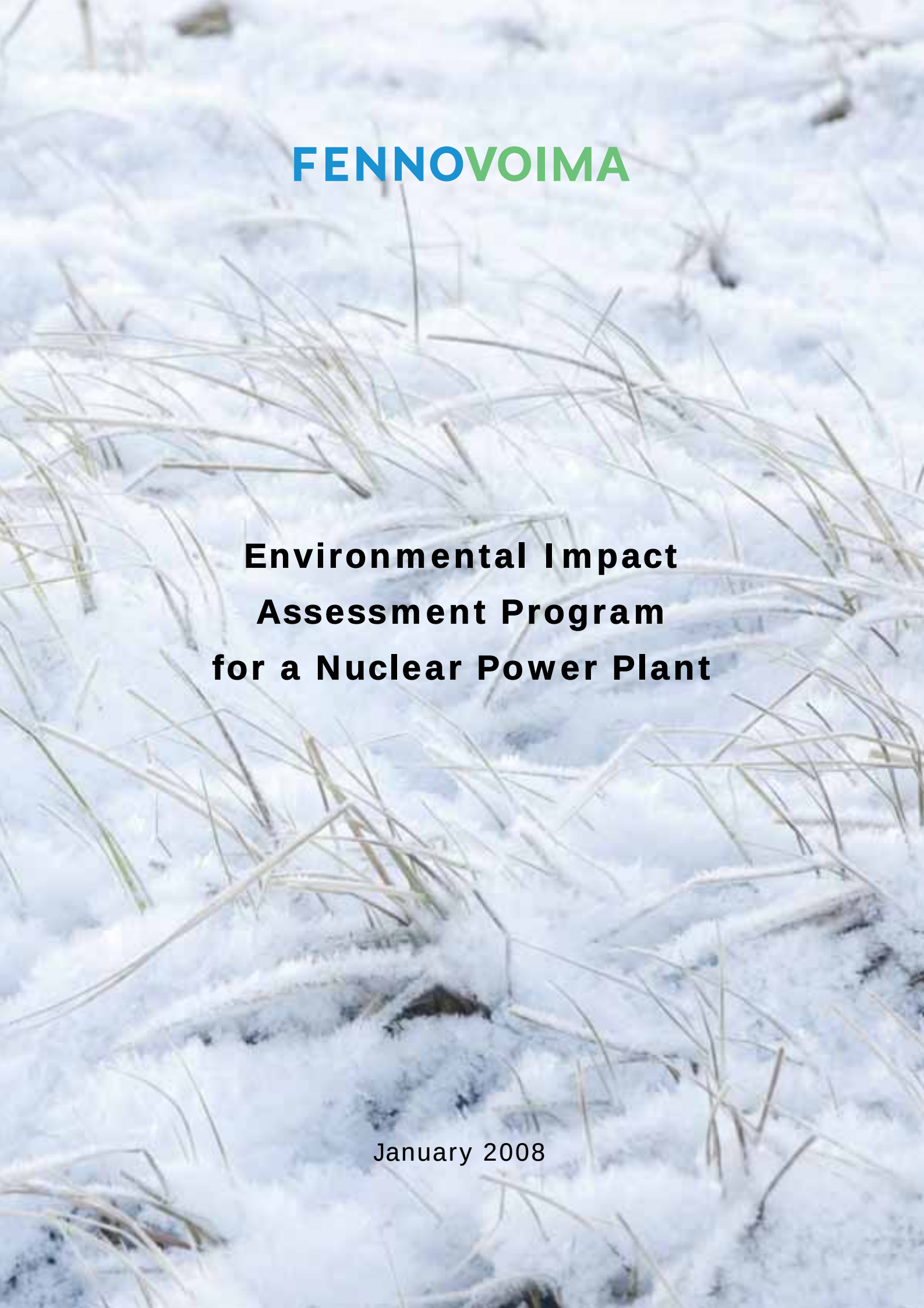

Environmental Impact Assessment Program for a Nuclear Power Plant

January 2008

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Cover photo: Early winter snow in Pyhäjoki in January 2008.

Environmental Impact Assessment Program for a Nuclear Power Plant

January 30, 2008

Fennovoima Oy

Winter conditions will also be taken into account in the environmental impact assessment. Snow has covered the ground in Pyhäjoki in January 2008.

“Planned reviews include dispersion model calculations for cooling water, the power plant’s landscape impact assessment and the assessment of impact on the regional economy and employment.”

Summary of the environmental impact assessment program

In January 2008, Fennovoima Oy, a Finnish energy company, started the statutory environmental impact assessment procedure (EIA procedure) in order to assess the environmental impact of a new nuclear power plant to possibly be built in Finland.

Nuclear power plant and its possible location

A nuclear power plant with the electric power of 1,500 –2,500 MW will be reviewed in the EIA procedure. The power plant may consist of two plant units and a disposal site for low- and medium-level radioactive waste.

The alternative locations for the nuclear power plant are Norrskogen and Kilgrundet in Kristinestad, Hanhikivi in Pyhäjoki, Kampuslandet and Gäddbergsö in Ruotsinpyhtää and Karsikko and Laitakari in Simo. The plant's location and intake and discharge alternatives for cooling water will be identified in these areas.

The report will also inspect the zero option, in which the power plant will not be built.

EIA program and report

At the first stage of the EIA procedure, an assessment program will be prepared, in which the project information, the options to be assessed, information about the licences required by the project, a description of the current environmental situation in the location areas and the assessment methods will be presented. In addition, a plan on the organization of the assessment procedure and participation will be presented, as well as the project's planning and implementation schedule.

In the second stage of the EIA procedure, a report on the project's environmental impact will be prepared based on the EIA program and the related opinions and statements, i.e. the EIA report. In the EIA report, the project's impact on air quality, water systems, soil, vegetation, animals, landscape and the built environment will be described and assessed. In practice, the project's environmental impacts will be assessed by identifying the current status of the environment and assessing the changes arising from the project and their significance.

Operational impacts on health, soil, community structure and the utilization of natural resources will be identified in the EIA procedure. Agriculture in Simo in January 2008.

Planned surveys include dispersion model calculations for cooling water, the power plant's landscape impact assessment and an assessment of the impact on the regional economy and employment. A resident survey will be used to identify the attitudes of those living within the power plant's vicinity towards the project. This survey will also support the project's social impact assessment. The EIA report will also identify the environmental impact of accidents.

Everyone can participate

For nuclear power plant projects, the Ministry of Employment and the Economy acts as the legal coordinating authority in the EIA procedure. It will ensure that the assessment program and report are displayed, compile all statements and opinions and issue a separate statement.

Fennovoima, together with the Ministry of Employment and the Economy, will organize information and discussion meetings open for the public in the municipalities of Kristinestad, Pyhäjoki, Ruotsinpyhtää and Simo at the program and report stages of the environmental impact assessment procedure. The public will have the possibility to receive information about and discuss the EIA procedure with Fennovoima, the Ministry and the experts who have prepared the EIA program. In addition, an audit group consisting of the most central stakeholders has been formed in each municipality to guide and monitor the environmental impact assessment process.

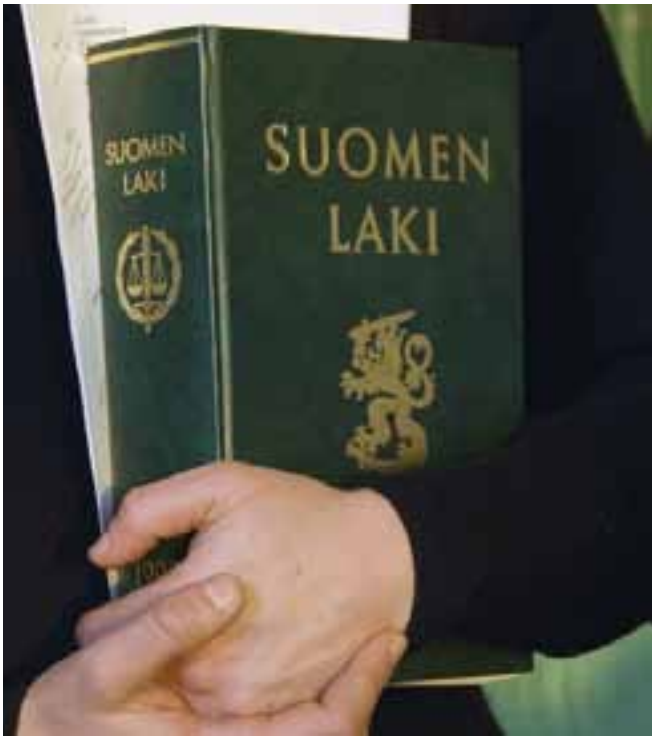
Transboundary environmental impact assessment has been agreed upon in the Espoo Convention. A party to the Convention has the right to take part in an environmental impact assessment procedure carried out in Finland if the country in question is affected by the environmental impacts of the project to be assessed. The Ministry of the Environment is responsible for carrying out the contractual obligations in Finland. The Ministry of the Environment will notify the environmental authorities in the surrounding countries of the commencement of the EIA procedure for Fennovoima's nuclear power plant project and inquire if they want to take part in the EIA procedure.

The environmental impact assessment report is to be completed in the autumn of 2008 and the project's EIA procedure is to be completed in early spring 2009.

Licencing procedures after EIA

The licencing procedures required by the project cannot be launched until the environmental assessment procedure has been completed. The decision-in-principle pertaining to the Nuclear Energy Act is applied for using an application submitted to the Finnish Council of State, in which several alternatives for the power plant's location can be presented. In addition, the construction and use of the power plant require construction and operation permits pertaining to the Nuclear Energy Act, an environmental permit pertaining to the Environmental Protection Act and licence decisions pertaining to several other acts.

The objective is to begin production in the new nuclear power plant by 2018.



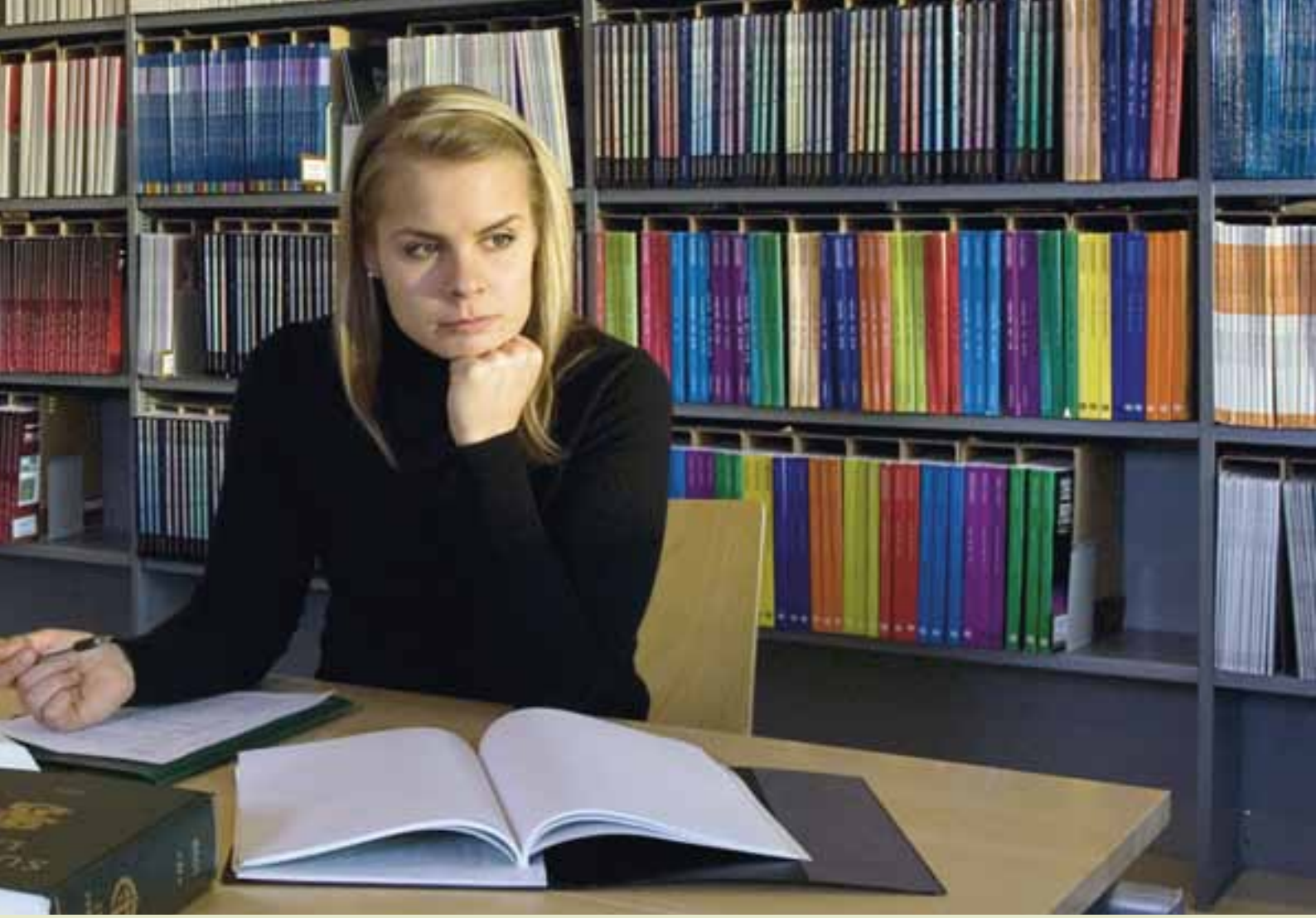
The EIA procedure is based on law.

Environmental impact assessment is carried out for all projects that could cause significant environmental impacts. Transportation cases in Simo in January 2008.

Contents

The environmental impact assessment of the new nuclear power plant will be displayed in libraries located in the EIA municipalities. Viikki Science Library in Helsinki in December 2007.

“Fennovoima Oy, the company responsible for the project, is a Finnish energy company that was established in 2007 and is owned by 64 industrial and energy companies. Fennovoima produces electricity for the needs of its owners at cost price.”



1 Project

Fennovoima Oy (hereinafter “Fennovoima”) is examining the construction of a nuclear power plant with electric power of 1,500–2,500 MW in Finland.

The construction of a new nuclear power plant requires a decision-in-principle from the Finnish Government and confirmed by Finnish Parliament. According to the Act on Environmental Impact Assessment (hereinafter “EIA Act”, 468/1994), the Environmental Impact Assessment report must be attached to decision-in-principle application regarding the new nuclear power plant can be issued.

In 2007, Fennovoima studied different location areas for the new nuclear power plant. The location area stands for a geographically indicated area where the power plant’s more detailed location is to be identified. Out of the alternatives studied, the following areas have been selected for further analysis and environmental impact assessment:

Hanhikivi cape in Pyhäjoki, Kampuslandet island and Gäddbergsö cape in Ruotsinpyhtää, Karsikkoniemi cape and Laitakari island in Simo and Norrskogen and Kilgrund islands in Kristinestad.

A completed EIA procedure is also a requirement for starting the licence procedures required by the project. The first licence procedure is the decision-in-principle application submitted to the Finnish Government. If the decision-in-principle is made and Finnish Parliament confirms it, Fennovoima will select the plant area according to the terms in decision-in-principle and apply for a construction permit for the nuclear power plant in accordance with the Nuclear Energy Act (990/1987). In this report, plant area stands for an area extending to a radius of about one kilometer from the nuclear power plant buildings, consisting of the power plant buildings, office buildings and support activity areas. Fennovoima’s objective is to start the production of the new nuclear power plant by 2018.

1.1 Party responsible

Fennovoima, the company responsible for the project, is a Finnish energy company established in 2007 which is owned by 64 industrial and energy companies.The principal shareholder of Fennovoima is Voimaosakeyhtiö SF

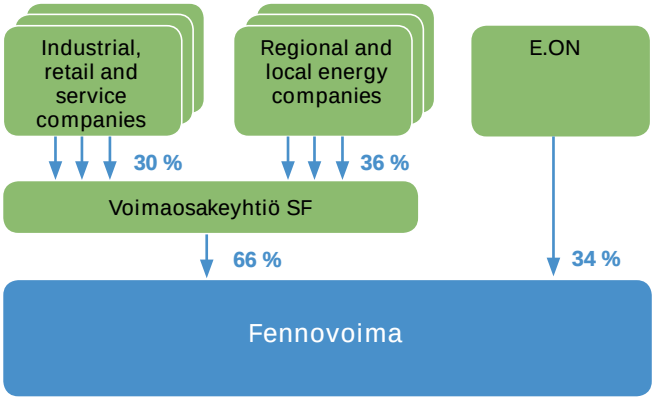
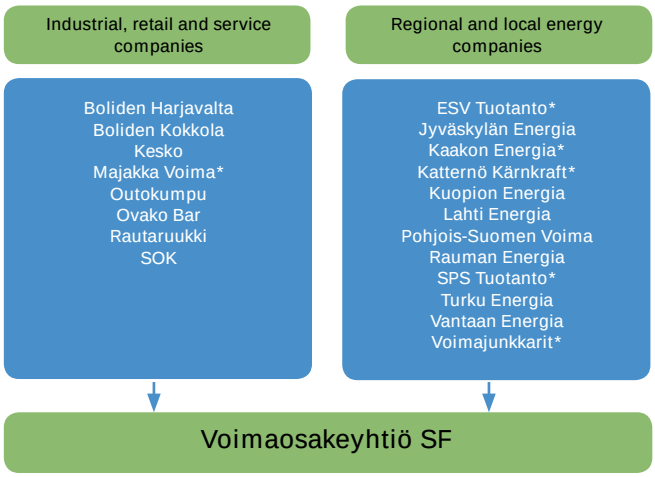


Figure 1-1. Fennovoima's ownership structure.



* Joint venture of indirect owners

Figure 1-2. Shareholders of Voimayhtiö SF.

AGA	Kruunupyyn Sähkölaitos	Porvoon Energia
Alajärven Sähkö	KSS Energia	Rantakairan Sähkö
Atria	Kuopion Energi	Rauman Energia
Boliden Harjavalta	Kuoreveden Sähkö	Rautaruukki
Boliden Kokkola	Köyliön-Säkylän Sähkö	Rovakairan Tuotanto
Componenta	Lahti Energia	Sallila Energia
E.ON	Lankosken Sähkö	Seinäjoen Energia
Esse Elektro-Kraft	Lehtimäen Sähkö	Suomen
Etelä-Savon Energia	Leppäkosken Sähkö	Osuuskauppojen
Finnfoam	Mondo Minerals	Keskuskunta
Haminan Energia	Myllyn Paras	Tammisaaren Energia
Herrfors	Mäntsälän Sähkö	Turku Energia
Hiirikosken Energia	Nurmijärven	Uudenkaarlepyyn
Imatran Seudun Sähkö	Sähkömyynti	Voimalaitos
Itä-Lapin Energia	Omya	VSV Energiapalvelut
Jylhän Sähköosuuskunta	Oulun Seudun Sähkö	Valio
Jyväskylän Energia	Outokummun Energia	Valkeakosken Energia
Kemin Energia	Outokumpu	Vantaan Energia
Keravan Energia	Ovako Bar	Vatajankosken Sähkö
Kesko	Paneliankosken Voima	Vetelin Sähkölaitos
Koillis-Satakunnan Sähkö	Parikkalan Valo	Vimpelin Voima
Kokemäen Sähkö	Pietarsaaren	Ålands Elandelslag
Kotkan Energia	Energialaitos	Ääneseudun Energia

Figure 1-3. Project participants.

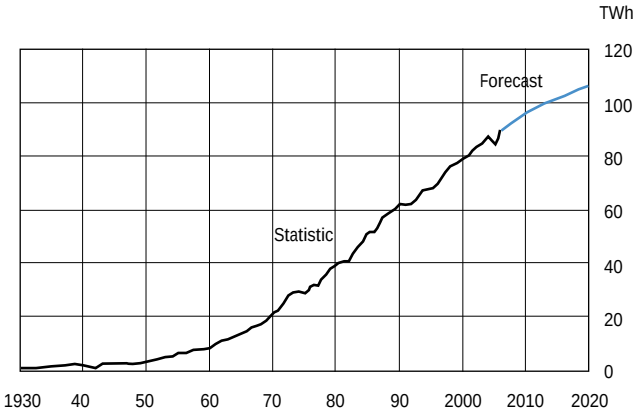


Figure 1-4. Total consumption of energy in Finland and a forecast by the Finnish Energy Industries of the development of energy consumption until 2020 (Finnish Energy Industries 2007).

holding 66 per cent of all shares and the minority shareholder is E.ON Nordic holding 34 per cent of all shares (Figure 1-1, Figure 1-2 and Figure 1-3).

Fennovoima is to produce electricity for the needs of its owners at cost price. Each owner receives production capacity by the amount corresponding to their share of ownership.

1.2 Purpose of the project and reasons

The consumption of electricity is constantly increasing in Finland at an annual rate of 1–2%. In 2006, about 90 TWh of electricity was used in Finland. The use of electricity is estimated to exceed 100 TWh in 6 to 8 years (Figure 1-4). *(Finnish Energy Industries 2007)*

According to the WAM scenario ("With Additional Measures" meaning the additional measures required for achieving the objectives set for greenhouse gas emissions) of the Ministry of Trade and Industry revised in 2005 (KTM, the Ministry of Employment and the Economy, TEM, as of January 1, 2008), the total consumption of electricity will be about 102 TWh in 2020 and about 105 TWh in 2025.

The total consumption of energy per capita is relatively high in Finland. Energy consumption is increased by our cold climate, sparse population, long distances and the structure of basic industry.

During the following years, old coal- and oil-operated power plants are being decommissioned due to environmental reasons and ageing.

Energy production must be increased in order to secure the operational requirements for and expand the operations of Finnish industry. The energy consumption of households is also increasing. According to the latest estimate, Finland will require at least 3,000 MW of new electricity production capacity by 2020 (Finnish Energy Industries 2007).

The purpose of the Fennovoima project is to respond to the increasing energy need in Finland. The new nuclear power plant will reduce Finland's dependence on imported electricity. It will increase energy production free from

carbon dioxide emissions and thus helping Finland in fulfilling its climate obligations. In addition Fennvoima's nuclear power plant will increase competition in electricity market.

1.3 Location and need for land use

The alternative location sites for the power plant are (Figure 1-5):

- Norrskogen and Kilgrund located in the south part of the municipality of Kristinestad. The distance to the central urban area is about 20 kilometers.
- The cape of Hanhikivi located in the north part of the municipality of Pyhäjoki. The distance to the town center is about 6–9 kilometers.
- The island of Kampuslandet and the cape of Gäddbergsö located in the south part of the municipality of Ruotsinpyhtää. The distance to the village is about 15 kilometers.
- The Karsikkoniemi cape located on the west side of the municipality of Simo and reaching the southeast boundary of the municipality of Kemi and the island of Laitakari located off the cape. The distance to the town center of Simo is about 20 kilometers.

The alternative sites of the nuclear power plant do not contain previous industrial activities. The future location of the power plant is subject to a real selection, for which the EIA procedure will provide important information.

A more precise location of the power plant in each alternative site will be identified during the EIA procedure. The purpose is to find the most favorable solutions considering the environment, local population and the plant's operations.

A land area of at least 50 hectares will be required for the nuclear power plant buildings. About 15 hectares of this area will be needed as the actual power plant site for the power plant buildings and auxiliary buildings and about 35 hectares will be needed during the construction for worksite operations. In addition, there will be a need for an intermediate storage area for soil, parking areas and accommodation areas.

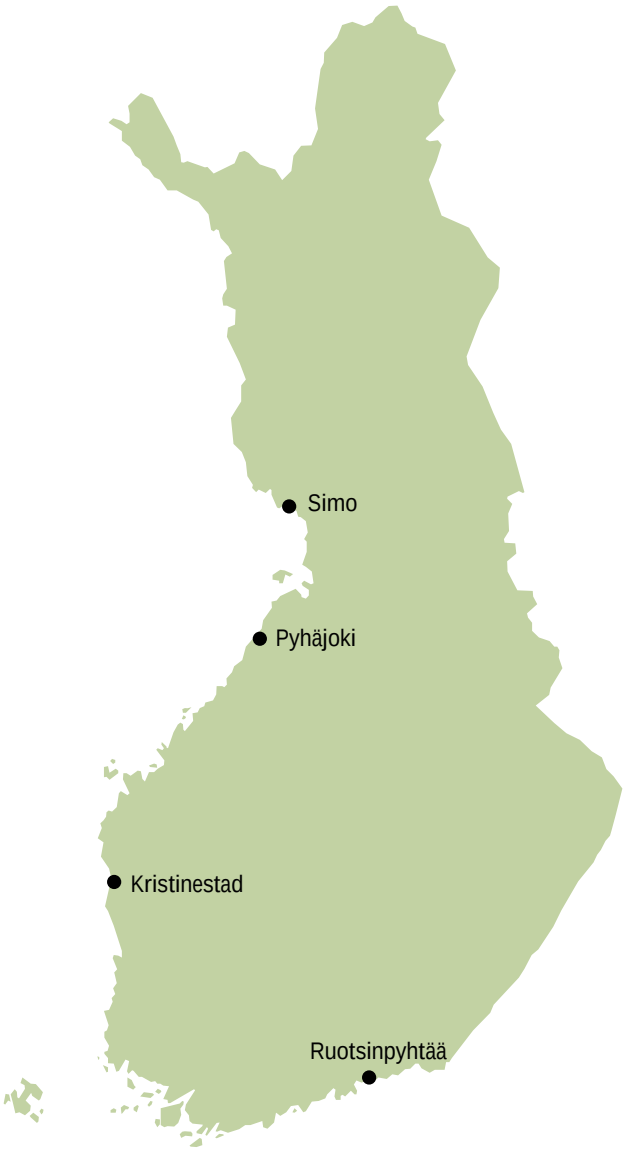


Figure 1-5. Alternative location sites for the nuclear power plant.

1.4 Estimate on the project schedule

If the Finnish Government makes a decision-in-principle and Parliament approves it, Fennovoima will complete the power plant-related acquisition agreements, select the plant site and apply for a construction permit for the nuclear power plant according to the Nuclear Energy Act and apply for other licences required to start the construction process.

The objective of Fennovoima is to start construction work in the selected plant site in 2012.

Before starting production in the nuclear power plant, Fennovoima will apply for an operation permit according to the Nuclear Energy Act, an environmental licence and other licences required for the power plant. Fennovoima's objective is that the new nuclear power plant can be commissioned by 2018.

1.5 Connection to other projects, plans and programs

Power transmission system

The project includes the construction of power transmission line connections from the power plant to the national grid. According to preliminary estimations for one nuclear

Simo, one of the four EIA municipalities, is located in Lapland. Simojoki river in January 2008.

power plant unit will be required two power lines of 400 kV and one power line of 110 kV.

The environmental impact of the construction and use of the power line to the national grid will be presented in this EIA procedure. Depending on the length of the connection lines required, among others, the construction of new transmission lines may also require a separate EIA procedure. Fingrid Oyj will be responsible for any changes to the power transmission network from the connection point onwards, as well as the related environmental impact assessments.

The new nuclear power plant may also require an increase in the national reserve power.

Disposal of spent nuclear fuel

The project includes the disposal of spent nuclear fuel from the power plant operations in Finland according to the requirements of the Nuclear Energy Act.

In Finland, Posiva Oy, owned by Teollisuuden Voima Oy (TVO) and Fortum Power and Heat Oy (Fortum), is building disposal sites for used nuclear power plant fuel in Olkiluoto in Eurajoki. From 1997 to 1999, Posiva carried out an EIA procedure regarding the disposal of spent fuel for six nuclear power plant units (currently operating Loviisa 1 and 2, Olkiluoto 1 and 2, currently constructed Olkiluoto 3 and the new reactor) in Olkiluoto, Äänekoski, Kuhmo or Loviisa. Posiva announced in January 2008 that they will start EIA procedure during 2008 for final disposal capacity increase.

After receiving the decision-in-principle concerning the disposal of spent nuclear fuel of the four currently operating power plant units in 2001 and the disposal of spent nuclear fuel of the unit currently under construction in 2002, Posiva started the construction of the underground rock characterization facility, ONKALO, in the Olkiluoto bedrock. Posiva's purpose is to apply for a construction permit for the final repository in 2012 and start the disposal of spent nuclear fuel in 2020.

For the disposal of spent fuel from new nuclear power plants, a separate decision-in-principle made by the Finnish Government and confirmed by Parliament will be required.

Nuclear power plant projects in Finland

In addition to the nuclear power plant project of Fennovoima, environmental impact assessment procedures regarding two other new possible nuclear power plant units are ongoing in Finland in 2007. TVO investigates supplementing the Olkiluoto nuclear power plant with a fourth plant unit and Fortum investigates supplementing the Loviisa nuclear power plant with a third plant unit. Both of these units have electric power of 1000–1800 MW. These projects are separate from Fennovoima's nuclear power plant project. However, any combined impacts of these projects and Fennovoima's project on the environment on immediate surroundings will be assessed.

UN Framework Convention on Climate Change and the Kyoto Protocol

The United Nations Framework Convention on Climate Change, also known as climate convention, was approved in the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992. It entered into force in 1994.

In the United Nations Climate Change Conference held in Kyoto, Japan in December 1997, the EU objective was approved for reducing total greenhouse gas emissions by eight per cent from the 1990 baseline, which was 4,238 million tonns (EU-15). The obligation must be achieved in 2008–2012, which is known as the first commitment period. The EU countries agreed upon their mutual allocation of this objective of emission reduction in June 1998. For Finland, the objective of reducing greenhouse gas emissions was set 0% below the 1990 baseline, i.e. the emissions must be at the 1990 level during the period of 2008–2012 (71.09 million tonns). Negotiations on actions after 2012 to reduce green house gases after has started.

When converted to equivalent tonns of carbon dioxide, Finland's greenhouse gas emissions were 69.3 million tons in 2005. The figure includes the carbon dioxide absorbing effect of forests *(Statistics Finland 2006)*. According to estimates, the emissions will exceed the permitted emission amounts by about 60.4 million tonns in 2008–2012, or by an average of 12.1 million tonns per year *(Finnish Government decision, February 22, 2007)*.

EU energy strategy

Each member country of the EU is independently responsible for its energy policy and its policy on the use and further construction of nuclear power capacity. However, EU policies have a significant impact on the energy policy of the member countries. The Energy Policy for Europe was published on January 10, 2007. According to its starting point, the energy policy must respond to how the EU can secure competitive and clean energy supply in compliance with controlled climate change, increasing global demand for energy and uncertainties in energy production.

A ten-point action plan has been issued for implementing the strategy. One of the points deals with the future of nuclear energy. The Commission considers nuclear energy to be a noteworthy energy source if the EU member countries are to reach the strict emission targets in the future. The Commission considers that advantages of nuclear power include its relatively stable and low production costs as well as low carbon dioxide emissions. Because, according to the International Energy Agency, IEA, the use of nuclear power is increasing globally, the Commission requires the EU to maintain and develop its technological lead in the sector. The Commission advices the authorities of the member countries to improve the efficiency of their nuclear licensing procedures and eliminate unnecessary restrictions to enable the industry to act quickly if required in the context of decisions concerning additional nuclear power construction.

One objective of the energy policy is to reduce 20% of greenhouse gas emissions of energy consumption by 2020 of the 1990 baseline.

National energy and climate strategy

On November 24, 2005, the Finnish Government approved a report to Parliament regarding the actions it is to carry out in its energy and climate policy in the near future (Finnish Government's report VNS 5/2005). In this report, the government proposed an strategic plan, with which Finland can achieve the obligations of the United Nations Framework Convention on Climate Change to reduce greenhouse gas emissions, as well as the reduction obligation in accordance with the EU's internal burden-sharing. The strategy takes into consideration Finland's starting points for international negotiations regarding the restriction of global greenhouse gas emissions after the Kyoto period. According to the strategy, any low-emission or emission neutral and cost-efficient production forms, including nuclear energy, will not be excluded in the future when building new capacity.

The Parliament's Commerce Committee approved the report on June 2, 2006 (Commerce Committee report TaVM 8/2006). On June 6, 2006, Parliament approved the Commerce Committee report concerning the Government report (Minutes of the plenary session document PTK 66/2006).

The EIA procedure produces information about the project's environmental impact to support decision-making. The construction of the new nuclear power plant requires a permit from the parliament. Stairs of the parliament building in December 2007.

"The licence procedure pertaining to the Nuclear Energy Act regarding the construction of a new nuclear power plant starts by applying for a decision-in-principle from the Finnish Government. The environmental impact assessment report (EIA review) referred to in the EIA Act must be enclosed with the decision-in-principle application."

2 EIA procedure

The Directive on Environmental Impact Assessment (85/337/EEC) issued by the Council of the European Community (EC) has been implemented in Finland through the EIA Act (468/1994) and Decree (713/2006) by virtue of Appendix twenty (XX) of the agreement on the European Economic Area. According to point 7 b) of the project list in § 6 of chapter 2 of the EIA Decree, nuclear power plants are projects subject to the assessment procedure.

The objective of the EIA procedure is to improve the environmental impact assessment and uniform its consideration in planning and decision-making. The objective of the procedure is to increase the availability of information to public, their possibilities to participate in project planning and express their opinions about the project.

The EIA procedure does not involve any project-related decision and it does not solve any licensing issues. The objective is to produce information to support the decision-making process.

According to the Nuclear Energy Act, the licence procedure regarding the construction of a new nuclear power plant starts by applying for a decision-in-principle from the Finland's Government. The environmental impact assessment report (EIA report) referred to in the EIA Act must be included in the decision-in-principle application.

The EIA procedure includes the program and report stages. The EIA program is a plan for arranging the environmental impact assessment procedure and the required additional studies.

At the initial stages of the EIA procedure, the EIA program shall be submitted to the coordinating authority. The Ministry of Employment and the Economy acts as the coordinating authority for projects accociated with nuclear facilities according to the Nuclear Energy Act. The Ministry of Employment and the Economy announces the public display of the EIA program in local newspapers and on Ministry's website. The announcement also specifies the period when public can express their opinions towards the EIA program.

The Ministry of Employment and the Economy com-

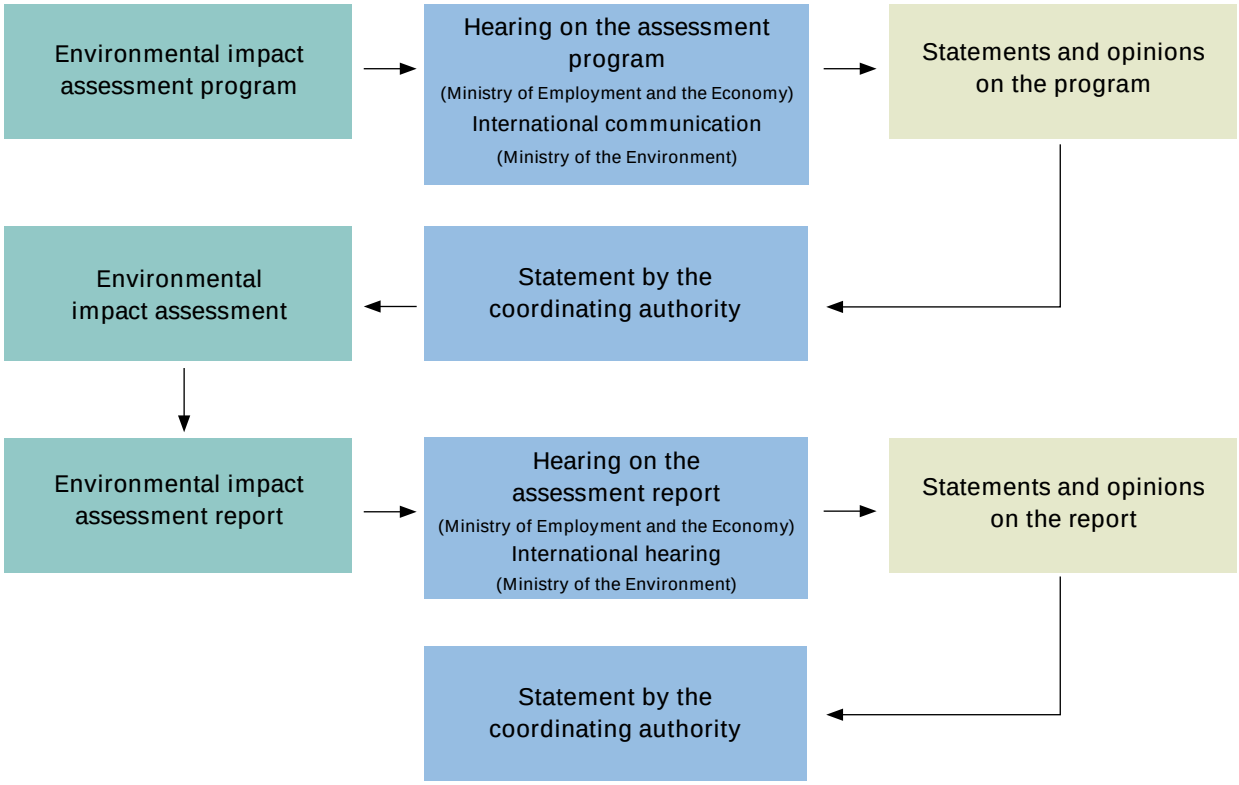


Figure 2-1. Stages of the EIA procedure.

piles all statements and opinions on the EIA program and issues its own statement. The EIA report is prepared on the basis of the EIA program and the related opinions and statements. The key stages of the EIA procedure are illustrated above (Figure 2-1).

The EIA review presents information about the project and a uniform summary of the project's environmental impact created as a result of the assessment procedure. The following points are to be presented in the EIA report:

- The alternatives to be assessed
- The current status of the environment and when possible the changes in current status such as impacts of climate change
- The environmental impacts of the alternatives and the zero alternatives, as well as their significance
- Comparison of the alternatives assessed
- Prevention and reduction methods for hazardous impacts
- A proposal for the monitoring program of environmental impacts
- Methods how interaction and participation have been arranged during the EIA procedure
- The extent to which the statement of the Ministry of Employment and the Economy on the assessment program has been taken into account in the assessment

Once the EIA report has been completed, all citizens will have the opportunity of presenting their opinions. The Ministry of Employment and the Economy acting as the contact authority requests the statements on the EIA report from the required parties.

The EIA procedure will end when the Ministry of Employment and the Economy submits its statement on the EIA report to Fennovoima. The licence authorities and Fennovoima will use the assessment report and the statement of the Ministry of Employment and the Economy as basic material in their decision-making processes. The project-related licence decision must state how the assessment report and the related statement are taken into account in the decision. The planned schedule of the EIA procedure is presented in the following figure (Figure 2-2).

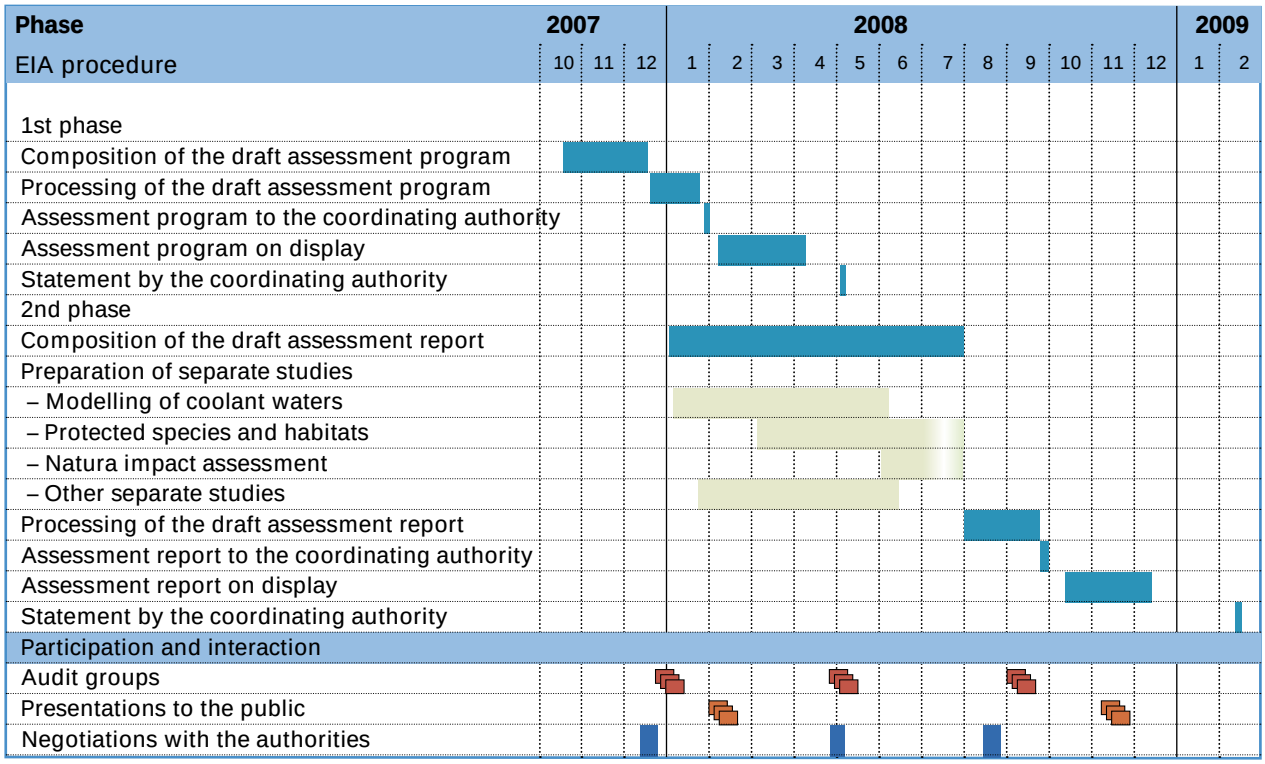


Figure 2-2. The planned schedule for the EIA procedure.

During 2008, the Ministry of Employment and the Economy, together with Fennovoima, will organize briefing and discussion events open to the public. In December 2007, Fennovoima organized a separate event for the public in Ruotsinpyhtää.

"Four monitoring groups consisting of different interest groups have been established and appointed by the EIA consultant to monitor the EIA procedure – one for each alternative location municipality. In meetings, the monitoring groups follow the progress of the environmental impact assessments and present opinions on the drawing up of the environmental impact assessment program and review, as well as other supporting reports."

3 Communications and participation plan

One of the central objectives of the EIA procedure is to improve project communications and the citizens' possibilities of participation. The EIA procedure's communications and participation plan is presented in the following chapters in accordance with the stages of the EIA procedure. The communities participating in Fennovoima's EIA procedure are presented below (Figure 3-1).

3.1 Audit group work

Four audit groups consisting of different interest groups have been established and appointed by the EIA consultant to monitor the EIA procedure – one for each alternative location municipality. The purpose of the audit groups is to advance information flow and exchange between the project leader, the authorities and other interest groups. The following communities were appointed to the audit groups:

Kristinestad

- The Town of Kristinestad
- The Town of Närpes
- The municipality of Karijoki
- The municipality of Isojoki
- The municipality of Merikarvia
- The municipality of Teuva
- The Ministry of Employment and the Economy
- The Radiation and Nuclear Safety Authority
- The State Provincial Office of Western Finland
- The West Finland Regional Environment Center
- The TE Center for Ostrobothnia
- The Regional Council of Ostrobothnia
- The Safety Technology Authority
- The Western Finland Environmental Permit Authority
- Kristinestad–Karijoki municipal healthcare federation
- The Ostrobothnia Rescue Department
- Posiva
- Kristinestad–Isojoki fishing area

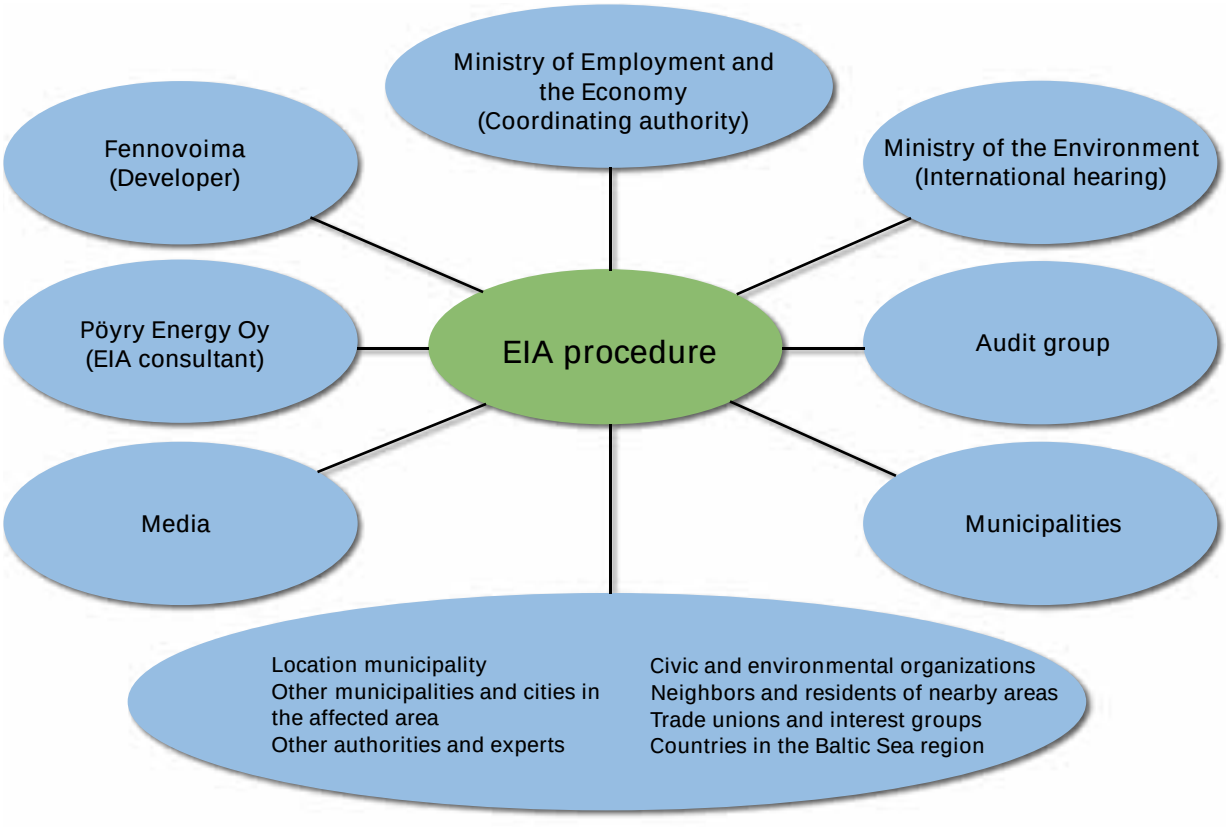


Figure 3-1. Parties participating in the EIA procedure.

- The Suupohja Ornithological Society
- Pohjanmaan vesiensuojeluyhdistys ry (Ostrobothnia water conservation society)
- Keski-Pohjanmaan kalatalouskeskus (Central Ostrobothnia fishery)
- Österbottens Fiskarförbund
- Suupohjan Ympäristöseura
- Sydbottens Natur och Miljö
- The Ostrobothnia Chamber of Commerce, Vaasa office
- The Sideby village association
- The Skaftunga village association

Pyhäjoki

- The Municipality of Pyhäjoki
- The Town of Raahe
- The Municipality of Alavieska
- The Town of Kalajoki
- The Municipality of Vihanti
- The Municipality of Merijärvi
- The Municipality of Siikajoki
- The Town of Oulainen
- The District of Raahe
- The Ministry of Employment and the Economy
- The Radiation and Nuclear Safety Authority
- The State Provincial Office of Oulu
- The North Ostrobothnia Regional Environment Center
- The TE Center for Northern Ostrobothnia
- The Council of Oulu Region
- The Safety Technology Authority
- Posiva
- The Northern Finland Environmental Permit Authority
- The Raahe District Joint Municipal Authority of Healthcare
- Jokilaakso Rescue Department
- Partners in the Piehinki Fishing Corporation
- Hanhikivi.net
- The Raahe District bird watchers Surnia ry, the Oulu Trade Center, the Raahe Trade Center Department
- The Pyhäjoki Region Nature Conservation Society
- Perämeren kalatalousyhteisöjen liitto (Union of fishing organizations in the Gulf of Bothnia)
- Entrepreneurs in Pyhäjoki
- The Piehinki village association

– The Parhalahti Town Committee
– MTK-Pyhäjoki
– The Parhalahti Joint Society

Ruotsinpyhtää
– The Municipality of Ruotsinpyhtää
– The Municipality of Pyhtää
– The Town of Loviisa
– The Municipality of Lapinjärvi
– The Municipality of Liljendal
– The Municipality of Pernaja
– The Municipality of Elimäki
– The Town of Anjalankoski
– The Ministry of Employment and the Economy
– The Radiation and Nuclear Safety Authority
– The State Provincial Office of Southern Finland
– The Uusimaa Regional Environment Center
– The TE Center for Uusimaa
– The Uusimaa Regional Council
– The Safety Technology Authority
– Posiva
– The Western Finland Environmental Permit Authority
– The Loviisa Healthcare District
– The Eastern Uusimaa Rescue Department
– Skärgårdens Vänner i Strömfors
– Strömfors Fiskeområde
– The fishing area of Ruotsinpyhtää
– Strömfors Fiskargillet
– Nylands Fiskarförbund
– Östra Nylands Fågel och naturskyddsförening
– Itä-Uudenmaan ja Porvoonjoen vesien- ja ilmansuojeluyhdistys
– Itä-Uudenmaan luonnon- ja ympäristönsuojeluyhdistys
– Etelä-Suomen Merikalastajain Liitto

Simo
– The Municipality of Simo
– The Town of Kemi
– The Municipality of Keminmaa
– The Municipality of Tervola
– The Municipality of Ranua
– The Municipality of Ii
– The Ministry of Employment and the Economy
– The Radiation and Nuclear Safety Authority
– The State Provincial Office of Lapland
– The Lapland Regional Environment Center
– The TE Center for Lapland
– The Regional Council of Lapland
– The Safety Technology Authority
– The Northern Finland Environmental Permit Authority
– Posiva
– The Länsi-Pohja Healthcare District
– Lapland Rescue Department
– Hepolan pientaloyhdistys
– Simonkylä Joint Society
– Lapin luonnonsuojelupiiri (Lapland nature conservation society)
– The Maksniemi cooperative of water supply and sewerage
– Partners in joint Maksniemi water areas
– Simon mökkiläisyhdistys (Simo cottage society)
– The Maksniemi village association
– Pohjoisen perämeren ammattikalastajat (Professional fishermen in the northern Gulf of Bothnia)
– The Lapland Ornithological Society
– Gulf of Bothnia fishing area
– Perämeren kalatalousyhteisöjen liitto (Union of fishing organizations in the Gulf of Bothnia)

The authorities act as experts within their audit group. Their participation in the audit groups and discussions do not bind them in any way when later issuing their authority statements referred to in the EIA Act.

In meetings, the audit groups follow the progress of the environmental impact assessments and present opinions on the drawing up of the environmental impact assessment program and report, as well as other supporting reports. The audit groups met once during the EIA program stage. The meetings were held in Pyhäjoki on January 8, 2008, in Simo on January 9, 2008, in Ruotsinpyhtää on January 10 and in Kristinestad on January 15, 2008. In the meetings, the project, EIA procedure and the project's EIA program draft were presented to the audit group members.

The following subjects were considered important according to the comments of the audit groups:

In the definition of the zero-option, the variation of the electricity production structure, the possible increase of the use of renewable energy and on the other hand the impacts on the development and use of renewable energy resources should be taken into account. The assessment should include the environmental effects of construction and that of strengthening the national power transmission system due to the new nuclear power plant as well as whether the plant needs adjusting power or reserve capacity. The completion of the descriptions of the present state of the environment was considered necessary. It was also considered important to assess the combined impacts of nuclear power plant and activities existing or being planned in the vicinity of the location area.

When assessing the impacts of the cooling water, for example, the lowering of the water level on the shores where land uplift occurs was considered important to be taken into account. On the other hand also the effects of the climate change, like the rising of the water level and fresh water increase due to increased precipitation, as well as the nutrient load increase from the rivers were consid-

In the EIA procedure, all inhabitants can share their ideas of the project. Kristiina ground in December 2007.

ered important. Also the impacts of nuclear power plant on the ice conditions should be assessed. The characteristics of the local water system like the depth, bottom and ice conditions, as well as the impacts on the migratory fish populations and the survival of new species should be taken into account.

In the comments, attention was paid on that the studies concerning vegetation, animals and conservation areas should be regionally extensive enough and all the relevant species should be included in the assessment. The impact assessment was wished to cover also the areas for the power lines and roads as well as waterways needed for the plant. The impacts on the possibilities to use goods from nature, hunting, fishing, picking berries and mushrooms in the vicinity of the nuclear power plant raised questions. It was considered important to assess the amount and availability of the needed soil and rock resources and the environmental effects connected to their use and transportation. The assessment of the noise impacts of the plant was considered important. The restrictions of the location site due to the land use plans as well as on the value of the properties should also be taken into account. The impacts of the project on the people's living conditions and means of livelihood as well as the social impacts of the construction should be assessed.

Disposal of spent nuclear fuel as well as the consideration of different risks and accident situations, like terrorism, oil accidents, pack ice and exceptional weather conditions raised questions in the audit groups.

The audit groups also presented additional information and clarifications about the local environment for the chapter concerning the present state of the environment in EIA program. The audit groups also provided the consultant information on the literature and reports concerned to be important in the assessment of the environmental impacts. The audit groups criticized the short commenting period of the EIA program draft.

The audit groups also presented questions, for example about economic issues, which are not in the scope of EIA. The consultant delivered these questions to Fennovoima Oy, which will answer those if possible on their website (http://www.fennovoima.fi/yritys > > Vastauksia yleisimpiin kysymyksiin).

All comments and specifications received in the meetings and afterwards were taken into account as comprehensively as possible when drawing up the EIA program, as far

as they were related to the EIA program. Otherwise, the comments, received information and sources of information were taken into account in the implementation of the EIA procedure and in the EIA report. The audit groups will meet for the second time after the coordinating authority issues its statement on the assessment program. For the third time, the audit groups will meet to discuss the EIA report at its draft stage.

3.2 Information and discussion meetings regarding the project's environmental impact

Fennovoima, together with the Ministry of Employment and the Economy, will organize information and discussion meetings open for the public in the municipalities of Kristinestad, Pyhäjoki, Ruotsinpyhtää and Simo at the program and report stages of the environmental impact assessment procedure. In these meetings, the nuclear power plant project, the EIA procedure and the EIA program will be presented and the public will have the possibility of presenting their views of the environmental impact assessment work and its sufficiency. The public will have the opportunity of receiving information about and discussing the EIA procedure with Fennovoima, the Ministry of Employment and the experts who have drawn up the EIA program.

The first public meeting will be organized on February 7 – February 13, 2008.

3.3 Display of the assessment program and international hearing

The Ministry of Employment and the Economy will notify of the public display of the assessment program after its completion in Kristinestad, Pyhäjoki, Ruotsinpyhtää and Simo and their surrounding municipalities on bulleting boards, regional media and the most important national newspapers.

The notification will state where the assessment program is displayed and where any related statements and opinions are to be submitted. The deadline for sending opinions will start on the date that the notification is released and its duration is a minimum of 30 days and a maximum of 60 days in accordance with the EIA Act. In addition, the Ministry of Employment and the Economy requests statements on the EIA program from several organizations.

The Ministry of the Environment will be responsible for the practical arrangements of the international hearing referred to in the Convention of the United Nations Economic Commission for Europe on Environmental Impact Assessment in a Transboundary Context (67/1997). The Ministry of the Environment will notify the environmental authorities in the surrounding countries of the starting of the EIA procedure for Fennovoima's nuclear power plant project and identify their willingness to take part in the project. The EIA program's summary translated in the required languages will be enclosed with the notification.

3.4 The contact authority's statement on the EIA program

The Ministry of Employment and the Economy will compile all statements and opinions given by different parties regarding the EIA program. The Ministry will issue its statement on the EIA program within a month from the date that the program's public display ends. The statement will be displayed in the same locations as where the EIA program had been displayed.

The EIA report will be drawn up on the basis of the EIA program, the related opinions and statements and the coordinating authority's statement.

3.5 Display of the assessment report

The Ministry of Employment and the Economy will notify of the public display of the assessment report after Fennovoima has delivered the report to the Ministry. The public display will be organized similarly to the assessment program. The deadline for sending statements and opinions to the contact authority will start on the date that the notification has been released and its duration is a minimum of 30 days and a maximum of 60 days in accordance with the EIA Act.

3.6 The coordinating authority's statement on the EIA report

The EIA procedure will be ended when the Ministry of Employment and the Economy issues its statement on the EIA report. This will take place within two months of the termination of the deadline reserved for statements and opinions.

3.7 Resident survey

A resident survey will be carried out during the EIA procedure. Its purpose is to increase interaction by providing Fennovoima with information about the residents' attitudes towards the project and providing the residents with information on the project and its impact on their living environment.

3.8 Other communications

The copies of the EIA program and report will be available at the Fennovoima offices for free and online on Fennovoima website (EIA section), on which there is also other information about the project and EIA procedure available. EIA program and report will be also displayed online on the website of the Ministry of Employment and the Economy (www.tem.fi > Energia > Ydinenergia > > Uusien ydinvoimahankkeiden YVAt). Documents will be delivered for display to several locations at municipali-

Fennovoima distributes information about nuclear power and environmental impact assessment to households in the EIA municipalities. Reading the Raahen Seutu paper in December 2007.

ties of four alternative power plant sites, for example to libraries.

Fennovoima will open offices with local contact person in each alternative power plant location. Information about nuclear power and environmental impact assessment will be available at the offices.

Fennovoima will prepare a brochure of EIA program in Finnish and in Swedish. The brochure will be available at the local offices, at libraries of the alternative locations and in the public meetings.

Two information sheets will be delivered to the households in the surroundings of alternative sites through the delivery of local news papers. The first information sheet will be delivered after the EIA program is submitted and it will present the project, nuclear power and EIA procedure. The second information sheet will be delivered after the EIA report is completed and will present the results of the environmental impact assessment.

Fennovoima will also inform about the project by using press releases or by organizing press conferences.

3.9 International hearing

The environmental impact assessment across boundaries has been agreed upon in the so called Espoo Convention (Convention on Environmental Impact Assessment in a Transboundary Context). Finland ratified this Convention of the United Nations Economic Commission for Europe *(67/1997)* in 1995. The Convention entered into force in 1997.

A party to the Convention has the right to take part in an environmental impact assessment procedure carried out in Finland if the country in question is affected by the hazardous environmental impacts of the project to be assessed. Correspondingly, Finland has the right to take part in an environmental impact assessment procedure of a project located in another country if the project's impact may affect Finland.

The Ministry of the Environment will be responsible for the practical arrangements of the international hearing. The Ministry of the Environment will notify the environmental authorities in the surrounding countries (countries in the Baltic Sea region and Norway) of the start of the EIA procedure for Fennovoima's nuclear power plant project and will identify their willingness to take part in the EIA procedure. The international hearing document translated in Swedish and/or English and other required language is to be enclosed with the notification.

The current status of the environment is the starting point for comparing different alternatives. Forest in Ruotsinpyhtää in December 2007.

“During the EIA procedure, the environmental impact of operations taking place within the plant area and outside its boundaries will be assessed. Operations extending beyond the plant area include traffic during the construction and use of the power plant, the construction of traffic connections and the construction of electric transmission connections.”

4 Options to be assessed

The project inspects the construction of the new nuclear power plant in four alternative location areas:
Option 1: Kristinestad: Norrskogen and Kilgrund
Option 2: Pyhäjoki: Hanhikivi
Option 3: Ruotsinpyhtää: Kampuslandet and Gäddbergsö
Option 4: Simo: Karsikkoniemi and Laitakari

The placement of the nuclear power plant, the required cooling water structures, traffic connections and power lines and other technical plant solutions that have a significant environmental impact will be identified during the EIA procedure. Thus environmental issues can be taken into account in planning.

The nuclear power plant alternatives to be assessed are:
– A plant of 1 500–1 800 MW with one nuclear power plant unit and reactor
– A plant of 2 000–2 500 MW with two 1 000–1 250 MW nuclear power plant units and reactors

In case of two nuclear power plant units, the units are to be constructed partly in parallel so that the first site advances 1–2 years ahead of the other. Both units will be light water reactors.

In addition to the nuclear power plant, the project includes the storage of spent nuclear fuel created through the operations of the new power plant in the plant area, the handling, storage and disposal of low- and medium-level power plant waste and the decommissioning of the power plant, as well as the handling and disposal of the decommissioning waste.

The project also includes:
– Intake and discharge arrangements for cooling water
– Supply and handling systems for service water
– Handling systems for wastewater
– Construction of roads, bridges and banks
– Construction of a loading platform for sea transport
– Construction of power transmission connections from the plant's switch field to the connection point of the national network

In autumn 2007, Fennovoima studied the suitability of several locations and selected four municipalities for the EIA procedure.
Nature in Ruotsinpyhtää in January 2008.

4.1 Zero-option

The zero-option is that Fennovoima's nuclear power plant project will not be implemented. In the zero-option, the increasing demand for electricity in Finland would be covered by increasing the export of electricity and/or through the power plant projects of other operators.

The environmental impacts of the zero-option will be illustrated by presenting a review of public assessments concerning the environmental impacts of different electricity production techniques. Fennovoima was established for the construction and use of the nuclear power plant because owners of Fennovoima consider nuclear power to be techno-economically and environmentally the most favorable way to produce the electricity they need.

4.2 Alternatives excluded from the assessment

Fennovoima has studied the suitability of several locations as the location area for the nuclear power plant and selected four municipalities for the EIA procedure. The suitability of the excluded locations has been reduced by different environmental and technical reasons due to which the locations have not been selected.

The total need for electricity in Finland depends on the general economical and social development, on which Fennovoima has no influence. Fennovoima does not have the energy saving means available that make the amount of electricity produced by the planned power plant unnecessary. Thus energy savings will not be reviewed as an alternative of the nuclear power plant project. For providing a good overall picture, the EIA report will present existing programs and decisions related to energy saving and improved energy efficiency, and their significance for the demand of electrical energy will be assessed.

The inspection of other possible power plant projects in the field as an alternative of Fennovoima's project is not possible because the plans or actions of parties acting in the electricity market are not known to Fennovoima and Fennovoima cannot influence them.

4.3 The current status as a point of comparison

The current environmental status generates a starting point for comparing and reviewing the implementation alternatives. The current status will be characterized based on the available material describing the status of the environment. Whenever possible, the probable changes in environment occurring in the long-term such as land uplift and climate change impact on increase of water level will be taken into account.

4.4 Limitation of the environmental impact assessment

During the EIA procedure, the environmental impact of

operations taking place within the plant area and outside its boundaries will be assessed. Operations extending beyond the plant area include traffic during the construction and use of the power plant, the construction of traffic connections and the construction of power transmission connections.

The manufacturing stages of the nuclear fuel used by Fennovoima will be carried out outside of Finland and the environmental impact of the related projects and operations have been identified as required by the legislation in the countries in question. Thus they will not be identified in this EIA procedure but they will be described based on typical production methods to provide an overall picture.

For spent fuel, the impact of temporary storage over several dozens of years and the transportation of spent fuel to the disposal site will be assessed. The environmental impact of the disposal of spent fuel will be assessed in a separate EIA procedure. To provide an overall picture, this EIA procedure will, however, describe the technical solution of the disposal planned in Finland and its environmental impact.

The impact of the construction and use of power transmission lines will be described for connections to the national network. Fingrid will be responsible for the required environmental impact assessment of power transmission lines.

The location areas do not contain any other industrial activities or other operations causing an environmental impact. The combined impacts of existing activities and the new nuclear power plant will be assessed in the EIA report. The combined impacts are for example in Ruotsinpyhtää area the impacts of the existing and the new nuclear power plant together in Loviisa, in Pyhäjoki are the combined effects of Rautaruukki steelworks and goldmine project of Laivajoki and in Simo area the combined effects of Veitsiluoto mill.

In this EIA procedure, the environmental impact will be assessed in areas separately defined for each impact type. The extent of the review area depends on the environmental impact under review. Environmental impacts will probably exist in an area smaller than the review area. The impact areas will be presented in the assessment report.

It will also be assessed during the EIA procedure whether the project will have an impact outside Finnish borders.

Assessment of the project's social and economic impact is also part of the EIA procedure. Hakaniemi market square in Helsinki in December 2007.

"Radioactive fuel is prevented from spreading into the environment using several technical spreading barriers. Each of these barriers must be sufficient to independently prevent the spreading of radioactive substances into the environment."

5 Project description

5.1 The operational principle of a nuclear power plant

A nuclear power plant turns heat into electricity similarly to large condensing power plants using fossil fuels. The main difference between a nuclear power plant and a traditional steam power plant is in the heat production method: heat in a nuclear power plant is produced in a nuclear reactor. The fuel used in a nuclear power plant is uranium dioxide (UO_2) enriched by isotope U-235. The use of uranium as a fuel is based on heat created in the splitting reaction of atom nuclei, i.e. fission. Conditions where the splitting of the U-235 nucleus creates a self-maintaining chain reaction are created in the reactor, resulting in controlled heat production. The fuel is enriched so that it contains 3–5% of isotope U-235. Only 0.71% of this easily splitting isotope is contained in natural uranium.

The fuel is placed in sealed tubes, i.e. fuel rods, as ceramic pellets. The fuel rods are compiled as fuel rod assemblies. New unused fuel contained by fuel rods can be handled and transported safely without any separate protection.

When neutrons hit a fissionable atom nucleus (generally U-235), it splits into two lighter nuclei. At the same time, new neutrons, neutrinos and energy are released. Neutrons created when the nucleus splits can cause new fissions, which makes the chain reaction possible. The fission reaction is controlled in the nuclear reactor and the energy released in the reactor core heats the water to produce high-pressure steam. The steam rotates the turbine which in turn drives the electric generator. More than one-third of the thermal energy created can be converted into electrical energy.

Heat produced in a nuclear power plant or other thermal power plants (coal, oil and gas plants) cannot be turned fully into electricity. As a result, part of the heat produced is removed using condensers where the low-pressure steam from steam turbines releases energy and turns back into water. Regularly, the condenser is cooled down using cooling water taken directly from the water system. The cooling water is then returned back to the water sys-

	Alternative 1	Alternative 2
Electrical power	1 500 – 1 800 MW	2 000 – 2 500 MW
Thermal power	4 500 – 4 900 MW	about 5 600 – 6 800 MW
Efficiency	about 37 %	37 %
Fuel	Uranium oxide UO_2	Uranium oxide UO_2
Thermal power released in cooling (to the water system)	about 3 000 – 3 100 MW	about 3 600 – 4 300 MW
Annual energy production	about 12 – 14 TWh	about 16 – 18 TWh
Cooling water need	60 – 70 m^3/s	90 – 100 m^3/s

Table 5-1. Preliminary technical specifications of the new nuclear power plant.

tem with a temperature 10°C higher.

The energy production of a nuclear power plant does not create any emissions into the air that are created through the combustion of fossil fuels. These emissions include sulphur dioxide, nitrogen oxides, particles or mercury and they involve health effects and cause the formation of ozone on the Earth's surface and acid rain. In practice, the operations of a nuclear power plant do not produce carbon dioxide or other greenhouse gases that cause global warming.

The test use of generators used as back-up power sources create small volumes of carbon dioxide, nitrogen dioxide, sulphur dioxide and particle emissions. Minor volumes of radioactive substances are released from a nuclear power plant into the air and water in a controlled manner through ventilation air and discharge water.

Spent nuclear fuel is highly radioactive. It is stored in appropriate and safe storage facilities until it can be disposed of in a manner that is safe for people and the environment. In Finland, the disposal is to be carried out inside deep bedrock.

The new nuclear power plant will be a base load plant which means that it will be used continuously at constant power, except for a few week outages at 12–14-month intervals. The plant's estimated operational lifetime will be at least 60 years.

5.2 Plant type alternatives

The most popular reactor type in the world is the light water reactor. Moreover, the reactors in the current nuclear power plants in Finland are light water reactors. Light water reactors use regular water to maintain the chain reaction and transfer heat from the reactor core. The alternative types of light water reactors are the boiling water reactor and the pressurized-water reactor.

Boiling water reactor

A boiling water reactor operates at the pressure of approximately 70 bar. Fuel heats the water which evaporates at a temperature of just below 300°C. The steam is led to rotate the turbine, to which an electric generator is connected (Figure 5-1).

Steam from the turbines is led to a condenser where it releases its remaining heat into the water system and condenses into water. From the condenser, water is pumped to pre-heaters where it is heated using steam taken from the turbine before the water is led back to the reactor. The condenser is underpressurized, due to which any leakage flows towards the process and not outwards from the plant.

A boiling water reactor does not require a separate heat exchanger for boiling steam or separate equipment for maintaining the reactor's pressure. Thus the plant's structure is simpler than that of a pressurized-water reactor plant. However, the steam is radioactive when the plant is running and nobody can stay close to the turbine during operations.

In Finland, the current units at the Olkiluoto power plant of Teollisuuden Voima contain boiling water reactors.

Pressurized-water reactor

In a pressurized-water reactor, fuel heats water but high pressure prevents the formation of steam. High-pressure water is led from the reactor to separate steam generators where the water circulates in thin tubes and heat is transferred to low-pressure water in a separate circuit located around the tubes (secondary circuit, Figure 5-2). Water in the secondary circuit evaporates and the steam is led to rotate the turbine and electric generator. Pressurized water is pumped back into the reactor from the steam generators (primary circuit). In the reactor, pressure is typically about

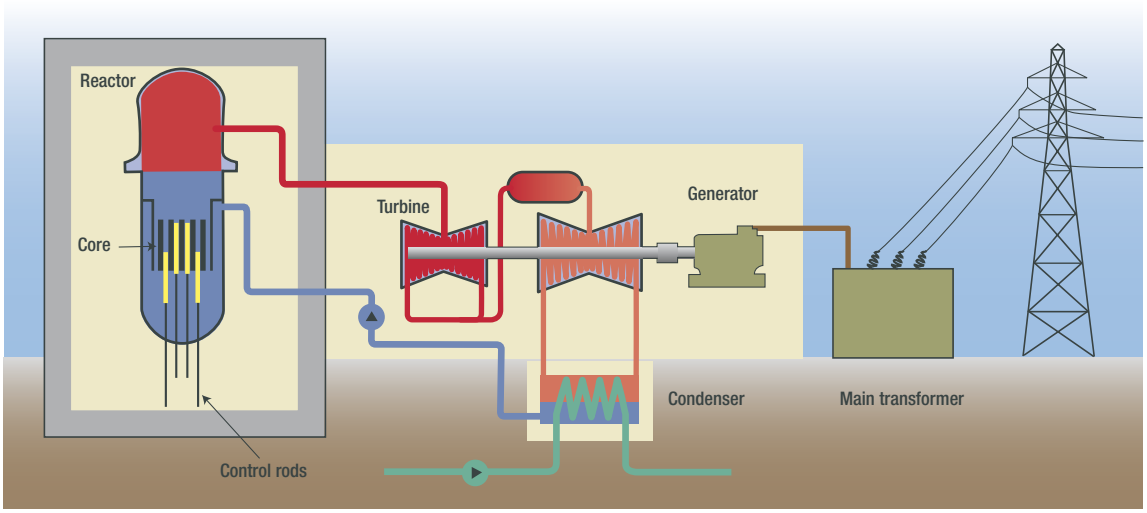


Figure 5-1. The operational principle of a boiling water reactor.

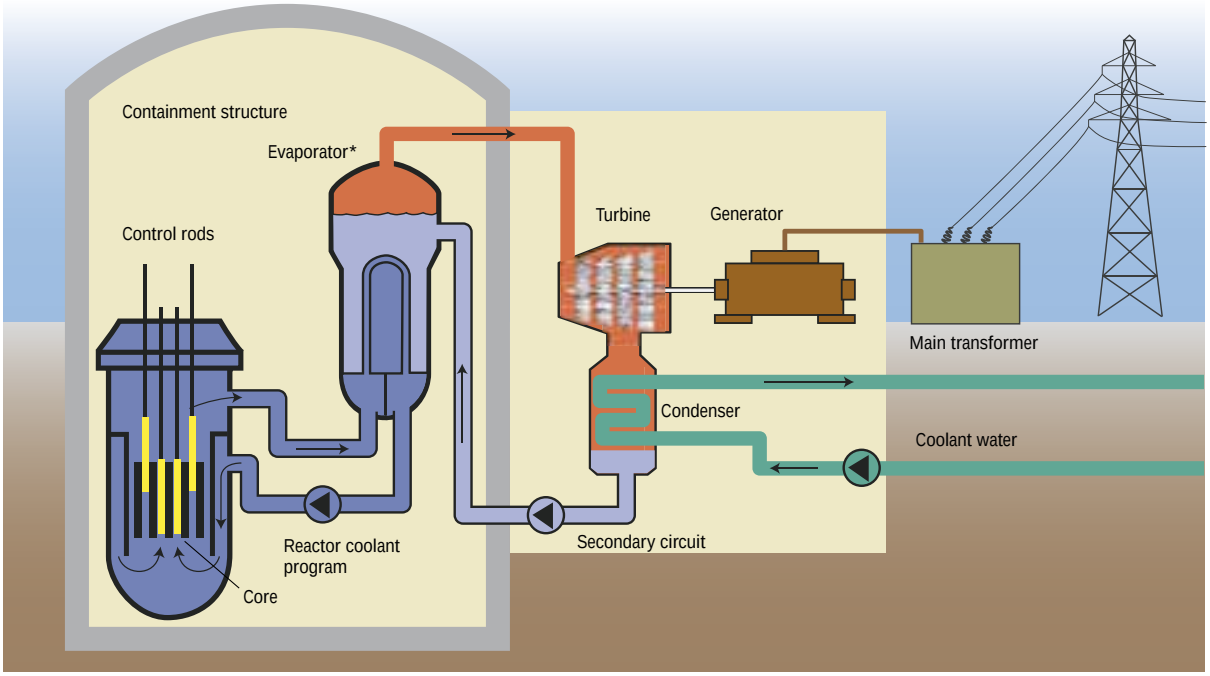


Figure 5-2. The operational principle of a pressurized-water reactor.

150 bar and the temperature is about 300°C.

Because of the heat exchanger, the steam of the reactor system and turbine plant is kept separate. As a result, water in the secondary circuit is not radioactive.

In Finland, the current reactors at the Loviisa power plant of Fortum and the reactor in the new power plant unit in Olkiluoto under construction are pressurized-water reactors.

5.3 Nuclear safety

The general principles of safety requirements for nuclear power plants valid in Finland are prescribed in the Finnish Government Decisions 395-397/1991 and 478/1999, and their details are issued in the YVL Guide published by the Radiation and Nuclear Safety Authority (Nuclear Power Plant Guide). According to the Nuclear Energy Act, nuclear power plants must be safe and they must not cause any danger to people, the environment or property. The safety requirements must be taken into account in the design of the plant. The holder of a licence authorizing the use of nuclear energy is responsible for ensuring safe use.

Nuclear power plants have been developed and will be developed with regard to safety and reliability, taking into account experience, safety research results and scientific and technological development. Safety systems have been improved by increasing the number of parallel subsystems

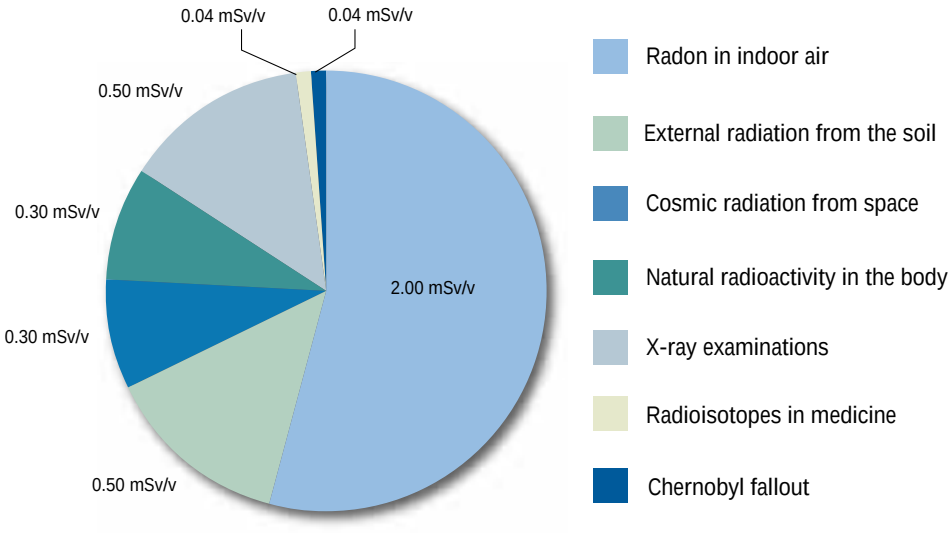


Figure 5-3. The origin of the annual radiation dosage of Finnish people (an average of 3.8 mSv).

and by implementing safety functions using several independent operational principles. In addition, subsystems have been separated physically from each other so that they are not exposed to a common danger, such as fire. Currently, the design of nuclear power plants prepares for the worst possible accident – the melting of the fuel core. Even though a serious reactor accident is highly improbable, plants must be designed to endure the effects so that there are no significant environmental impacts.

The safety of nuclear power plants is based on following the defense in depth principle. Several simultaneous and independent protection levels will be applied to the design and use of the power plant. These include:
– prevention of operating failures and accidents
– control of operating failures and accidents
– reduction of the consequences of accidents

Nuclear power plants are designed so that the failure of operations at one protection level does not result in danger to people, the environment or property. In order to guarantee reliability, each of the levels is built on several supplementing technical systems and limitations and regulations related to the use of the power plant.

Safety planning ensures that radioactive substances contained by the plant, and fuel in particular, can be prevented from spreading as reliably as possible in all situations. Radioactive fuel is prevented from spreading into the environment using several technical spreading barriers within each other. Technical spreading barriers include ceramic fuel pellets, metallic cans for fuel rods and cooling circuits that endure the reactor's pressure. A gas-tight containment building surrounding the reactor forms the outermost barrier. Each of these barriers must be sufficient to independently prevent the spreading of radioactive substances into the environment.

Reactors are designed to be naturally stable with regard to power control. This means that the reactor's inherent feedbacks limit any power changes. Safety in light water reactors is increased because a temperature increase in the coolant controls power increase and a coolant leakage in the reactor shuts down the chain reaction.

All safety-related equipment and functions are designed based on special safety inspections, taking into account improbable failures and applying sufficient safety margins. In addition, high quality requirements are applied to the manufacture of safety-related equipment. Despite this, safety planning always starts from the assumption that there may be equipment failure or plant operators may make mistakes. For failures and mistakes, nuclear power plants are equipped with automatic safety systems.

The capacity of safety systems is designed to be manifold in relation to the need so that they can be divided into several parallel subsystems. Because of multiplicity, the safety systems operate reliably and the reliability can be improved by using several devices of different types to perform one task. For the melting of the fuel core, plants are equipped with special protection equipment and structures. The reliability of plants is maintained through continuous staff training and a high safety tradition.

5.3.1 Radiation and control

The power plant is required to have an environmental ra-

diation control program described in STUK's YVL Guide 7.7 and referred to in §26 of the Finnish Government Decision 395/1991. The program is used to control the emissions and the content of radioactive substances in the environment. The control program will include external radiation measurements and analyses of air, samples representing the different stages of food chains leading to humans and analyses of radioactivity within the human body. In addition, the program will include samples of so called indicator organisms that accumulate or concentrate radionuclides from the emissions. The program will define the sampling and analyses to be used. Samples will be taken from different locations at different times of the year.

The levels of external radiation will be measured continuously, resulting in real-time data about the changes in the environmental radiation status. The equipment will be part of the national radiation measurement network; thus serving the needs of regional control. The measurement results can be read in real-time at the Ministry of the Interior and at the Radiation and Nuclear Safety Authority. Radioactive substances can be easily detected in nature using measurement devices, and even a small amount of different substances can be recognized. As a result, artificial radioactive substances can be separated from nature's radioactive substances. These include uranium in the ground and different radioactive products produced as it degrades, such as radon. Radon in the indoor air causes half (2 mSv) of the annual average radiation dosage of Finnish people (3.8 mSv, Figure 5-3).

In addition to radiation originating from the soil and building materials, natural radiation includes radiation originating from the space and radioactive substances contained by foodstuffs. Radiation from the soil varies between different municipalities from 0.17 to 1 mSv/year (Figure 5-4). The largest volumes of external radiation occur in the rapakivi granite area in south-eastern Finland.

Considering the alternative location areas assessed in the EIA procedure, the volume of external radiation in the Kristinestad and Pyhäjoki areas is at the average level of radiation in Finland. The volume of external radiation is rather high in the Ruotsinpyhtää area compared with the average radiation in Finland, whereas the volume is rather low in the Simo area.

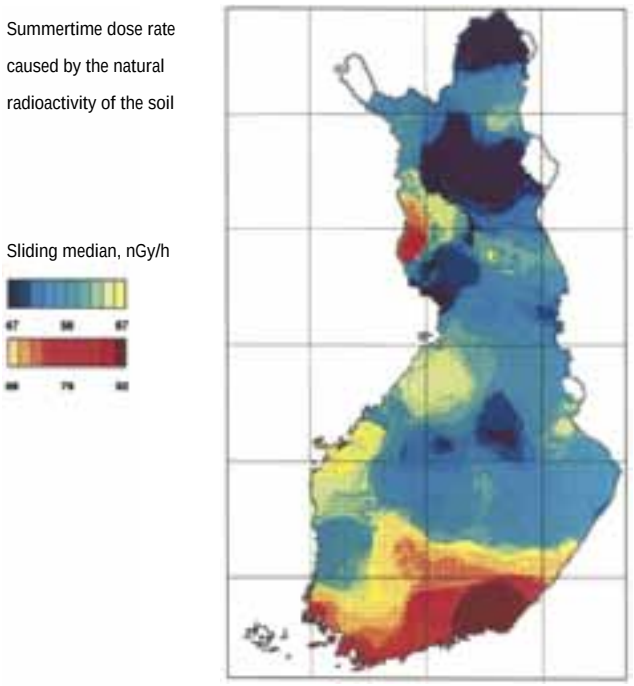


Figure 5-4. External gamma radiation in Finland. Dosage speed in the air in summer caused by natural radioactivity in the soil. The share of cosmic radiation (32 nGy/h) is not included in the values. Meter reading in the terrain in the area of the highest dosage presented in the map corresponds to the value 1.1 mSv/year (0.12 µSv/h, including cosmic radiation; STUK 2007)

5.3.2 Emergency operations

It is highly unlikely that an accident could take place in a nuclear power plant that would lead to the need to take action in the surroundings of the power plant to protect the population. However, there must be preparations for emergency operations in order to follow defense in depth. Emergency operations are regulated by detailed instructions issued by the Radiation and Nuclear Safety Authority. Emergency operations include plans for protecting people living or staying close to the power plant against the impact of accidents. These emergency operations are described in more detail on the website of the Radiation and Nuclear Safety Authority (*www.stuk.fi*) and will be described in this project's EIA report.

5.4 Procurement of fuel

The new nuclear power plant will use about 40–60 tonns of enriched uranium annually as fuel. 300–400 tonns of natural uranium will be required to produce this amount of fuel.

Stages of nuclear fuel procurement include: excavation and enrichment of raw uranium, conversion, isotope enrichment and the manufacture of fuel rod bundles.

Fennovoima will acquire the services, including the aforementioned stages, from the market using long-term agreements with producers. Currently, the largest countries producing uranium are Canada, Australia and Kazakhstan. Other significant uranium producers include Russia, United States and some African countries. The most significant conversion plants are located in France, Canada, England, United States and Russia. The enrichment market is dominated by four producers: Eurodif (France), Urenco (Great Britain, Germany, the Netherlands), Tenex (Russia) and USEC (United States). In addition, Japan, China and Great Britain have enrichment capacity. Depending on the plant type, suitable fuel rod

The safety of nuclear power plants is based on following the defense in depth principle. Pasila railway station in December 2007.

bundle manufacturers are in Germany, Sweden, France, Great Britain and Russia.

5.5 Waste management

The basis for the management of radioactive waste created in a nuclear power plant is that waste is isolated from the environment. According to the Nuclear Energy Act, nuclear waste must be handled, stored and disposed of in a permanent manner in Finland. The Nuclear Ordinance defines that nuclear waste must be disposed of in Finnish soil or bedrock. The disposal of nuclear waste is to be planned so that long-term safety can be secured without any supervision at the disposal site. According to international and Finnish reports, the required nuclear waste management operations can be carried out in Finland in a controlled and safe manner.

Radioactive waste created in a nuclear power plant includes:

– high-level waste consisting mainly of spent fuel
– low- and medium-level operating waste (e.g. maintenance waste and waste created through water purification)

In addition, nuclear power plants create regular waste.

5.5.1 Spent nuclear fuel

When the reactor is running, fission products created through the splitting of heavy uranium nuclei remain in the fuel. The majority of the splitting products are radioactive, due to which the spent fuel is highly radiating.

After removing fuel from the reactor, spent fuel will be stored for a few dozen years in the storage for spent fuel to be built next to the power plant, in which case the activity and heat production are significantly reduced. The storage will consist of 15-meter-deep water pools where water acts as a radiation shield and cools the spent fuel. After the storage, the power plant's spent fuel will be transported to the disposal site plant being built for this particular purpose.

According to the Nuclear Energy Act, the producer of nuclear waste shall be responsible for the maintenance of the spent fuel it has produced until the disposal site area is sealed, and is obliged to pay for all of the nuclear waste management expenses. In order to cover the expenses, a preparation charge is added to the price of nuclear electricity. It is debited by the producer of nuclear electricity to the nuclear waste fund administered by the Ministry of Employment and the Economy.

In 1995, Posiva Oy (Posiva) was established in Finland to handle the transportation of spent nuclear fuel from power plants to the disposal site and manage the actual disposal, any related research and other expert tasks belonging to its field. Posiva's founding shareholders are

Teollisuuden Voima and Fortum Power and Heat Oy. Posiva has started the construction of an underground rock research facility, ONKALO, in the bedrock of Olkiluoto. Posiva's purpose is to start the disposal of spent fuel in 2020.

5.5.2 Low- and medium-level waste

The majority of waste created during normal operations is low-level waste. This waste consists mainly of insulation material, paper, old work outfits, machine parts, plastic and oil, i.e. regular maintenance waste. Medium-level waste consists of ion exchange mass from process water purification systems and evaporation waste created when purifying sewage waters.

Low- and medium-level power plant waste will be disposed of in the final repository, which will be constructed for them in the power plant site. Wet waste will be solidified in a solidification plant to be built in the plant area. Power plant waste will be solidified, dried or absorbed into a suitable medium, such as bitumen or concrete.

5.5.3 Regular waste

Regular waste (e.g. paper, plastic or food waste) and hazardous waste (e.g. fluorescent lights and waste oils) will also be generated in the plant area. All waste will be managed as required by the power plant's environmental licence.

5.6 Radioactive emissions

The nuclear power plant will be designed and used so that the volume of radioactive substances released into the environment are below the limits set in legislation and licences.

All radioactive liquids and gases created in the nuclear power plant will be collected, delayed to reduce radioactivity and filtered. After filtering, small volumes of radioactive substances will be released into the air and water. Emissions released into the air contain noble gases, iodide, aerosols, tritium and radioactive coal isotope C-14. Emissions released into water contain fission and activation products and tritium. Emissions into the air will be released through the power plant's stack. Emissions released into the water system will be led to the cooling water channel.

5.7 Other emissions

In the case of failure in the external network connection, the nuclear power plant's electricity supply will be secured using diesel generators as sources of back-up power. Gas turbines could also be used. The test use of the diesel generators used as back-up power sources create small volumes of carbon dioxide, nitrogen dioxide, sulphur dioxide and particle emissions. In addition, any oil-operated auxiliary heat boilers will create small volumes of similar emissions. The test use of the gas turbine will create small emissions of nitrogen dioxide.

5.8 Water need and supply

5.8.1 Raw water

The need for fresh raw water in the power plant will be defined and the arrangements of water supply and sewerage will be identified during the EIA procedure.

5.8.2 Cooling water

Part of the heat produced in the nuclear power plant will be conducted to the water system using direct cooling. Cooling water taken from the water system will be used for cooling the turbine condensers. As the temperature of the cooling water decreases, the plant's efficiency will increase. The estimated flow rate of cooling water for a power plant with the electric power of 2 500 MW is about 100 m3/s using an even cooling water flow. The cooling water will be led back to the water system with a temperature increased by 8–12°C. The extent of the water area, where the surface is heated by more than one centigrade because of the discharge of the cooling water, depends highly on the weather conditions but it is estimated to be approximately 25 km^2.

Factors to be taken into consideration when selecting the intake and discharge location include the water system's currents and depth ratios, as well as other conditions related to the status of the water system, its use and the environment. The alternatives for the cooling water intake and discharge locations and cooling methods will be identified during the EIA procedure. Thus the environmental impacts can be taken into account in the best possible manner when making cooling water-related decisions.

5.9 Wastewater

Wastewater will be handled appropriately before it is released into the sewage or water system. Wastewater created in the power plant or plant area includes water from the raw water handling plant and desalination plant, water from the liquid waste management plant, flush water for traveling band filters, sanitary water and wastewater from washing plants.

The project's impact on the urban structure will also be assessed in the EIA report. Pyhäjoki center in January 2008.

"There has been no previous industrial activity at the alternative plant sites explored in this project or their immediate vicinity."

6 Present state of the environment

The present state of the environment is the starting point when comparing the alternatives. There is no previous industrial activity at or in the immediate vicinity of the alternative plant sites explored in this assessment. Therefore, there is slightly less information readily available on the state of the environment at these sites than on the environment in the vicinity of industrial sites.

More detailed information will be obtained through surveys conducted during the course of the environmental impact assessment process.

A field in Simo.

The Pyhäjoki locality is located along trunk road 8. Pyhäjoki in January 2008.

Hanhikivi in Pyhäjoki

6.1 Pyhäjoki, Hanhikivi

6.1.1 Land use and built-up environment

6.1.1.1 Activities located in the area and its vicinity

The Hanhikivi headland is located in Northern Ostrobothnia in the municipalities of Pyhäjoki and Raahe. Most of the headland, including the planned power plant site, is located in the region of the Pyhäjoki municipality, but a part of the northeast edge of the headland is located in the municipality of Raahe. The power plant location area is roughly indicated in the attached figure (Figure 6-1).

The population center of Pyhäjoki is located more than 5 kilometers south of the headland. The village of Parhalahti is located approximately 5 kilometers from the planned power plant site. The center of Raahe is located approximately 20 kilometers away.

There is no industrial activity in the immediate vicinity of the Hanhikivi headland. There are, for instance, engineering industry functions in the Pyhäjoki region. In the town of Raahe, some 15 kilometers from the Hanhikivi headland, on the coast of the Gulf of Bothnia, there are

Figure 6-1. Preliminary location area of the power plant in the area of the Hanhikivi headland.

Rautaruukki Corporation's steelworks, Oy Polargas Ab's air gas plant and, e.g., liquid gas storages. To the south of the municipality of Pyhäjoki, more than 20 kilometers from the Hanhikivi headland, there are danger zones of the Finnish Defense Forces Lohtaja site.

6.1.1.2 Land use planning

In the Hanhikivi headland area, land use is controlled by a regional plan and a shore master plan for the southern shore areas of Raahe.

Regional plan

The Northern Ostrobothnia regional plan, approved in 2005, is in force in the area of the Hanhikivi headland.

The regional plan contains several notes concerning the Hanhikivi cape region (Figure 6-2). The regional plan states that Northern Ostrobothnia is one of the key areas in Finland for the protection of land-uplift coasts. *(Municipality of Pyhäjoki 2007)*

The Hanhikivi headland area has been marked as a particularly important area in terms of biodiversity due to its habitat types and species. Important bird areas and important areas for threatened plants outside the conservation areas are marked as such areas. In addition to this, the Hanhikivi headland area is marked as containing a site of importance concerning the history of civilization and a nationally valuable fixed antiquity, regionally valuable heritage landscapes, a natural conservation area and Natura area to the southeast of the headland and to the south of the headland some 4 to 6 kilometers from the tip of the headland, and nationally valuable bedrock areas in terms of natural and landscape conservation.

In addition to the Hanhikivi headland, the entire coast of the municipality of Pyhäjoki has been marked as natural multi-use area. The note points out entities to be developed for recreational use containing valuable natural sites. There is a marked outdoor recreation route along the coast between the Hanhikivi headland and the village of Parhalahti.

Master plans

The master plan concerning the village of Parhalahti in the municipality of Pyhäjoki extends to some five kilometers from the Hanhikivi area. The master shore plan for the coastal areas of Pyhäjoki is under preparation. The Parhalahti Mustaniemi shore plan extends to the vicinity of Hanhikivi, some two kilometers from the headland. Additionally, the shore master plan for the southern parts of Raahe, approved in 1979, extends to the municipality border. The Raahe master plan, zone III, which was approved in 1979, is also in force in the area.

6.1.2 Landscape and cultural environment

Bare rock headlands and in general thin strata on top of

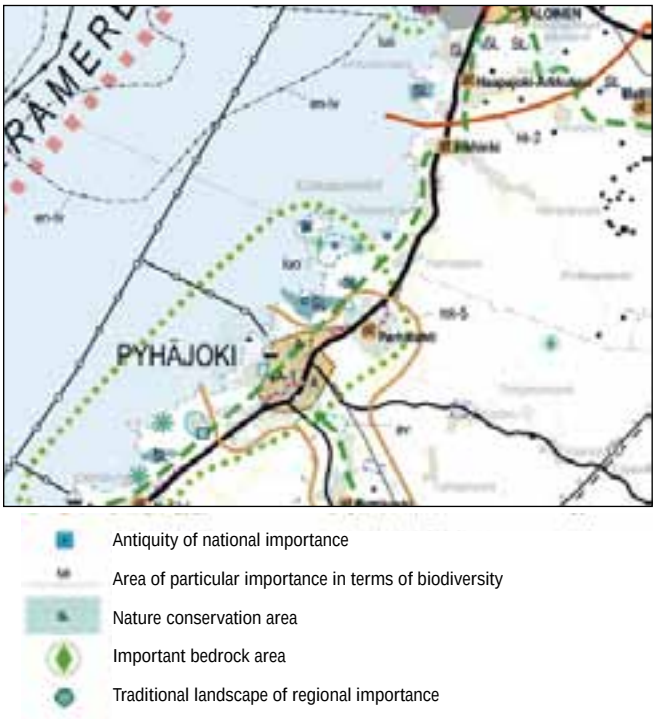


Figure 6-2. The Hanhikivi headland area in the Northern Ostrobothnia regional plan (2005).

the bedrock are characteristic of the Pyhäjoki coast. The cliffs are extensively bare above the shoreline as well. In large formation, the bedrock is rather even in terms of topography. Representative glaciated rock can be seen, for instance, in the rock headlands of the west shore of the Hanhikivi headland. In the coastal area, the tips of headlands are predominantly rock or stony shore. The coves have low-lying stony shores and sands.

The terrain of the Hanhikivi headland, three kilometers long and one kilometer wide, is even and very low-lying. Its highest parts rise to less than five meters above sea level. The Hanhikivi headland and its immediate surroundings are mostly in their natural state.

There are wide low-lying shore meadows along the north shore and base of the Hanhikivi headland. There are "fladas", sheltered bays beginning to separate from the sea that can even become separate pools during low water levels, along the shores of the Hanhikivi headland. There are also the large Hietakarinlahti and Heinikarinlampi gloe lakes in the Hanhikivi area. Gloe lakes are lakes that have distinctly become separate from the shoreline, with a connection to the sea only during high water levels with southerly and westerly gales. In addition, southeast to the headland, more than two kilometers away from the tip of the headland, there are the smaller Rovastinperukka and Liisanlampi gloe lakes. There are wide bare sands on the west coast of the Hanhikivi headland. The shore meadows are lined by a bush zone typical of coastal areas. There are also trees further from the shore amidst the bushes.

The Hanhikivi headland area has been classified as a

valuable bedrock area in terms of natural and landscape conservation. The area is important in terms of landscapes and very important geologically. *(Husa, J. et al. 2001)*

There is a boundary mark, Hanhikivi, originating from the historic times, in the Hanhikivi headland, a fixed antiquity protected by the Antiquities Act (295/63) and a nationally valuable site.

The nearest nationally important environment in terms of the history of civilization is the Parhalahti fishing harbor south of the headland. In addition, there is a traditional landscape of regional importance on the northern shore of the Hanhikivi headland, Takaranta, and a traditional landscape of regional importance southwest of the headland, the Maunus shore meadows. *(Northern Ostrobothnia Environment Center 1997)*

6.1.3 People and communities

The immediate surroundings of the planned plant area are sparsely populated. Settlement is confined to the base of the headland, southeast of the site. The details of settlement in the surroundings will be explored in the course of the EIA process once the more detailed location of the plant is known.

There are approximately 10,000 to 15,000 people living within a 20 kilometer radius from the planned power plant site. The population center of Pyhäjoki is located inside this area, as is a part of the Raahe population center. Smaller population centers in the area include Parhalahti, Piehinki and Yppäri.

There are approximately 370,000 people living within a hundred kilometer radius of the power plant site. Of these, a significant number lives in the Oulu region. The largest population centers in the area are Oulu, Kokkola, Raahe, Ylivieska, Kiiminki, Haukipudas, Kempele, Nivala, Oulunsalo and Kalajoki.

The Pyhäjoki coast is nearly entirely holiday home area. Holiday homes are scarcer in the Hanhikivi area than elsewhere in the Pyhäjoki shore areas. The holiday homes are located west of the headland.

The nearest sensitive sites, such as schools, nurseries and hospitals, will be explored and presented on a map in the assessment report.

6.1.4 Traffic

Trunk road 8 runs through the village of Parhalahti about 5 to 6 kilometers from the power plant location area. A smaller private road, Puustellintie, runs from the trunk road to the tip of the Hanhikivi headland.

The nearest railway station is located in Raahe, some 25 kilometers from the Hanhikivi headland by road. This railway section is used by freight traffic only. The nearest passenger train station is in Oulainen, some 50 kilometers from Hanhikivi.

The nearest significant port is located in Raahe. Plans have been made to make the currently 8.0 meters deep route of the Port of Raahe 10.0 meters deep in 2007–2008 (Port of Raahe 2007). The sea route leading south from the port towards Kvarken runs at a distance of approximately 15 kilometers from Hanhikivi.

The nearest airport is located in Oulu, some 100 kilometers from Pyhäjoki.

6.1.5 Noise

There are no functions causing significant noise in the vicinity of the power plant area. Waterborne traffic may cause occasional noise.

6.1.6 Soil, bedrock and groundwater

Soil and bedrock

The Hanhikivi headland is part of the Ostrobothnia schist belt, and the area's bedrock comprises of Hanhikivi conglomerate schist which differs geologically from the rest of the surroundings, containing nearly exclusively pebbles of volcanic origin. Conglomerate is distinctly visible in the low-lying rock surfaces of the area. Conglomerate extends under the sea, but at the mainland side, the headland is limited to gabbrodiorite. There is quartz-feldspar schist east of the headland.

The supracrustal rock is mainly sand, silt and clay. There is mainly micaceous schist and gneiss in the bedrock, and amphibolite, porphyrite and metagraywacke to a lesser extent. In addition to silicic granite, the complex also contains intermediate alkaline rock.

According to a geologic survey conducted in 2007 in the area (*Elminen et al. 2007*), the main rock type in the bedrock of the Hanhikivi area is metaconglomerate. The fragment size varies from the fines of the sand to basketball-sized blocks. The largest blocks are evenly distributed in the fines, i.e. the rock types are homogeneously mixed. In general, the bedrock in the area is firm. Only in places do the varying properties of the soil binders and blocks deteriorate the firmness of the bedrock. In addition, there are fissures sparingly, mainly narrow, a few centimeters thick. The seams are mainly long and straight.

There are a lot of exposures in the area, which indicates that the covering of soil is thin and the bedrock is even. Based on interpretations of morphological as well as magnetic lineaments, the Hanhikivi headland is comprised of monolithic bedrock

The Rovastinperukka area at Hanhikivi is valuable geologically, and the rocky shore areas of the headland are important as a geologic excursion destination.

Groundwater

There are no classified groundwater catchment areas in the power plant location area, and the area are no significant areas in terms of community water supply. The nearest groundwater catchment areas are located in Kopisto and

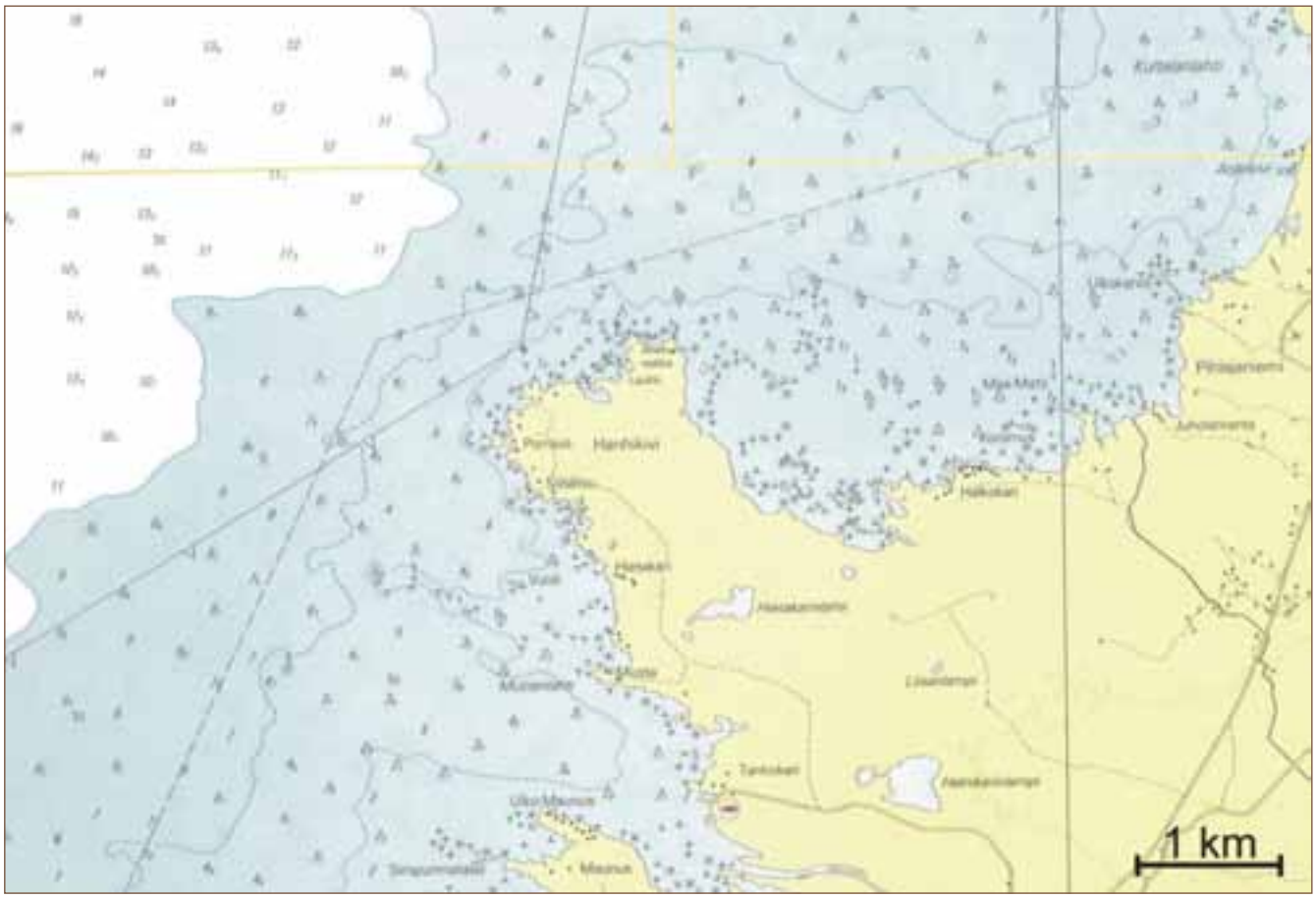


Figure 6-3. Extract from the nautical chart of the Hanhikivi headland area.

Haapakoski, some 10 kilometers south and southeast of the plant area.

6.1.7 Air quality and climate

6.1.7.1 Weather conditions

The Hanhikivi headland is located on the coast of the Bothnian Bay. The winter is long in the Bothnian Bay, and the temperature is relatively low for most of the year. The normal annual mean temperature at the coast measurement stations is 1 to 3°C. The Gulf Stream produces warm air masses that maintain a relatively mild winter temperature compared to other areas at similar latitudes.

The location of the Bothnian Bay in the western part of a great continent and also near the Atlantic Ocean causes the climate to vary between marine climate and continental climate, depending on the prevailing winds.

The vicinity of different climate zones causes winds to be variable in the Bothnian Bay region, especially in the winter. In the summertime, southerly and southwesterly winds prevail. Northerly winds are also common in the winter. Usually, the winds are moderate. *(Bothnian Bay Life 2007)*

6.1.7.2 Air quality and fallout

The quality of air is not monitored in the Pyhäjoki municipality, as there is no industry significant to the quality of air in the area, and there is no measured data for the region available. The nearest place where the quality of air is monitored is in the municipality of Raahe, where Rautaruukki's steelworks are located and where the quality of air is monitored within the frameworks of an extensive quality of air monitoring program.

The quality of air can be considered good in the Hanhikivi headland area, since there is no activity causing significant emissions into the immediate surroundings.

6.1.8 State and use of waters

6.1.8.1 General description and hydrologic data

The Hanhikivi headland, located on the coast of the Bothnian Gulf, extends some five kilometers out to sea (Figure 6-3). The coastal waters surrounding the headland are very shallow and rocky. An area of less than two meters deep extends to approximately one kilometer from the headland shore to the northeast of the headland. The surrounding sea area is open, albeit rocky at the coast.

Special characteristics of the Bothnian Bay include shallowness, brackish water due to high river water input discharge, natural oligotrophy and small, phosphorus-limited basic production and scarcity of species, the species being a mix of salt, fresh and brackish water species. In addition, the Bothnian Bay is specified by quick land-uplift and the resulting constantly changing littoral of the low-lying areas. The water mass is less stratal in depth than in the

southern parts of the Baltic Seas, which facilitates water mixing as far as the bottom. There is no tide and the fluctuations in water level are caused by weather conditions. The low salinity of the sea water, 0.2 % to 0.4 %, makes the Bothnian Bay the least marine among the basins of the Baltic Sea.

In the Bothnian Bay, currents are mainly caused by winds, and therefore their direction and strengths vary greatly. Along the Finnish coast, there is a distinct main flow to the north. There is a high amount of water flowing between the Bothnian Sea and the Bothnian Bay. There is mainly low-saline surface water flowing out and more salinic water of the Bothnian Sea flowing in. *(Bothnian Bay Life 2007)*

The Pyhäjoki river empties south of Hanhikivi. There are three power plants at the upper part of the river (Venetpalo, Vesikoski and Kalliokoski). In addition, in the middle part of the river, below Haapajärvi, there is the Haapakoski power plant, and in the population center of Pyhäjoki there is a power plant.

6.1.8.2 Sea area ice conditions, water quality and biologic state

Due to the relatively harsh climate and low salinity, the Bothnian Bay is covered with ice in the wintertime. Strong winds, especially from the southwest, can break ice and pile it towards the Finnish side, which may hinder shipping in the area. Usually, the formation of ice begins in the inner bays in mid-November and in the middle parts of the sea in January. Typically, the ice is 70 cm thick along the coast in the north, and 30 to 50 cm in the middle parts of the sea. Breaking up of the ice begins at the beginning of May in the south and in late May in the north. Most of the Bothnian Bay is covered with ice for a minimum of 120 days per year, the northernmost parts for more than half of the year. *(Bothnian Bay Life 2007)*

Water quality

The surface water of the Bothnian Bay contains very little phosphorus, and therefore the sea area's basic production is phosphorus-limited. In other parts of the Baltic Sea, nitrogen is the nutrient limiting the production of phytoplankton. In fresh water systems, phosphorus is usually the limiting nutrient, and the water of the Bothnian Bay is closer to fresh water in terms of salinity.

There is no eutrophication in the open parts of the Bothnian Bay. Problems with eutrophication occur mainly in the vicinity of the coast, the archipelago, shallow coastal areas with limited water turnover and off population centers and industrial plants. No oxygen-free sea bottom areas have been observed in the Bothnian Bay in recent years.

Water quality in the sea area next to Hanhikivi is represented by measurement results off Pyhäjoki and Raahe. The observation station off Pyhäjoki is located some nine kilometers west of the Pyhäjoki river estuary. Water turnover in the area is good, since the sea area is deep, open and free of islands at the observation station. The pollution load of the sea area off Pyhäjoki is mainly diffuse load. The observation station off Raahe is located in the Raahe archipelago, near the south tip of the Lapaluoto island. The center of the town of Raahe is located approximately four kilometers northeast of the observation station, and the steel industry production area slightly over a kilometer east of it. At the observation station, the sea area is deep and open to the south. Water turnover is good. Water quality at this observation station is influenced by pollution from the Raahe population center and the Rautaruukki industrial site.

The total phosphorus content at the observation station off Pyhäjoki has decreased slightly from the values in the beginning of the 1990s both at the sea bottom and close to it. The total nitrogen content at the observation station has decreased slightly between 1990 and 2004, but no considerable changes have taken place in the measurement values close to the bottom. Off Pyhäjoki, the salinity of the sea is approximately three per mille.

Based on water quality data from 1994 to 1997, the sea area off Raahe falls mainly into the category "good" and "satisfactory" off the town of Raahe and Rautaruukki. The chlorophyll a and phosphorus contents, indicative of eutrophication, have decreased in the sea area off Raahe in the 1990s, whereas nitrogen content off Rautaruukki has increased. *(Bothnian Bay Life 2007, Kippola et al. 2005, Pöyry Environment Oy 2007)*

Flora and fauna

Many of the organisms living in the Bothnian Bay are living at the limits of their tolerance of salinity and temperature. The low Kvarken sill forms an obstacle to the distribution of marine species of animals and plants. In the Kvarken region, there is a thinning of the species, and Kvarken is the boundary of northern distribution for many marine species. Bladder wrack (*Fucus vesiculosus L.*), acorn barnacle (*Balanus improvisus*), common mussel (*Mytilus edulis*), common cockle (*Cerastoderma glaucum*), common eider (*Somateria mollissima*), many amphipod and isopods are not found in the Bothnian Bay. *(Bothnian Bay Life 2007)*

The toxicity of many metals increases as salinity decreases, and therefore some metals may be more toxic in the low-saline Bothnian Bay than in other parts of the Baltic Sea. The period of growth is short in the Bothnian Bay, and therefore fish, for instance, grow slowly and accumulate rather high toxicity levels from the environment before they are full-grown. Unlike in eutrophicated sea areas, there is less bio mass in the Bothnian Bay and there is less sedimentation, which is why toxins in the water ac-

The Hanhikivi cape area contains a number of exposures and the soil covering is thin. The bedrock, belonging to the Ostrobothnian slate band area, is even. The area contains wetlands developing into bogs. Hanhikivi area in Pyhäjoki in September 2007.

cumulate in a smaller amount of organisms. This can be observed in the metal contents of organisms and sea bottom sediments.

Plankton production

Due to the short period of growth, the total production of phytoplankton remains at only a quarter of the plankton production of the Bothnian Sea. Mainly freshwater diatom species bloom in June in the Bothnian Bay. Inflorescence takes place only once a year, apparently due to the long ice winter, at a rather late stage. However, the ice coat of the Bothnian Bay and other arctic sea areas is not solely an obstacle to life; it also facilitates life. Certain species of phytoplankton are able to thrive within the crevices and pores of ice and the underside of ice. These are subsequently fed on by bacteria, zooplankton and other microscopic organisms. There are approximately five species of zooplankton in the Bothnian Bay, and among them copepods and water fleas are very important food for the Baltic herring and sprat.

The low production of phytoplankton is sufficient for covering only a part of the Bothnian Bay's organisms' need for energy and food. The organic matter and nutrients draining into the Bothnian Bay from river systems act as a supplementary source of energy and food for the heterotrophic organisms of the sea area. *(Bothnian Bay Life 2007)*

Aquatic vegetation

The salinity of sea water decreases gradually when going up the Gulf of Bothnia to the north, being between 2 to 4 per mille in the Bothnian Bay. Also, the species of aquatic vegetation change with the change in salinity. Marine species are gradually replaced by freshwater species as the salinity decreases. The large amounts of fresh water input to the northernmost corner of the Bothnian Bay make it possible for freshwater species to spread all the way to the outer archipelago.

At the water's edge, vegetation of the Bothnian Bay is mainly dominated by needle spikerush (*Eleocharis acicularis*) or small pondweed *(Potamogeton berchtoldii*) and in areas with a sandy bottom, Chara algae and horned pondweed (*Zannichellia palustris*). Deeper waters are dominated by claspingleaf pondweed (*Potamogeton perfoliatus*) and sheathed pondweed (*Potamogeton vaginatus*), but Chara algae no longer occur. The production of larger bottom-growing algae remains at only half of what it is in the Bothnian Sea. Bladder wrack (*Fucus vesiculosus L.*) is not present north of Kvarken. Instead, the occurrence of freshwater species of moss and green algae becomes more commonplace. *(Bothnian Bay Life 2007)*

Bottom fauna

There are no mussels in the northern parts of the Bothnian Bay basin due to low salinity. The number of macroscopic bottom fauna is considerably smaller in the Bothnian Bay than in the Baltic Sea proper. The benthic amphipods *Monoporeia affinis* and *Saduria entomon* are present in the Bothnian Bay, but the populations are smaller than in the Bothnian Sea. However, *Monoporeia affinis* forms a con-

siderable part of the bottom animal populations of the soft bottoms of the Bothnian Bay. *(Bothnian Bay Life 2007)*

6.1.8.3 Fish and fishing

Fish stocks vary with different environmental factors, such as salinity, depth or temperatures. The dominant species of the Bothnian Bay include cold water species, such as Baltic herring *(Clupea harengus L.*), vendace (*Coregonus albula L.*), whitefish (*Coregonus lavaretus*) and fourhorn sculpin (*Myoxocephalus quadricornis L.*), whereas warm water species, such as perch (*Perca fluviatilis*) and roach (*Rutilus rutilus L.*) become more commonplace towards the south. There are fewer marine species in the Bothnian Bay than in the Bothnian Sea. Many Bothnian Bay species spawn in river estuaries, since these warm up more quickly in the spring and offer more food compared to the outer archipelago. Therefore, fish stocks are very forcibly influenced by the state of river waters. Water regulation, water impurities and acidity may have a very strong impact on the fish stocks of the sea area.

Catches of Baltic herring have increased in the Bothnian Bay since 2000, and the Baltic herring stock has become stronger. Effective fishing with fine-meshed scoop nets has considerably diminished the sea trout and whitefish stocks of the Gulf of Bothnia. There have been no significant changes in the catches of northern pike by professional fishermen of the Bothnian Bay. The bulk of the catch of northern pike was caught from the Bothnian Sea and the Archipelago Sea. Vendace stocks have decreased in the Bothnian Bay from the 1970s onwards, and only recently has gradual recovery of the stocks been observed. The vendace stock of the Bothnian Bay is mainly regulated by fishing, but also biologic and abiotic (such as hydrochemical factors) may have a significant effect on the size of the stock. *(Finnish Game and Fisheries Research Institute 2006, Bothnian Bay Life 2007)*

No obligatory monitoring is carried out in the sea area off Pyhäjoki. The nearest areas of observation on the Bothnian Bay coast where the state of waters, fish stocks and fisheries are observed, are located in the sea area off Raahe, some 10 kilometers to the northeast of the Hanhikivi area.

A fishing inquiry was conducted on the sea area off Pyhäjoki for the first time in 2003. The number of professional fishermen in the sea area was 216. Those fishing in the sea area primarily fished in the village waters off Pyhäjoki, west of the Hanhikivi headland.

In 2003, the fishing season in the sea area lasted for more than six months. Marine fishing was keenest in early summer and autumn. Whitefish nets were used the most in the sea area off Pyhäjoki. Fyke and trap nets were also used a lot. Salmon, sea trout and vendace nets were used less commonly.

The catch from the sea area off Pyhäjoki amounted to approximately 14,000 kg in 2003, excluding fishing with fyke and trap nets. Whitefish, northern pike, Baltic herring and vendace were quantitatively the most common catches. Catches of salmon amounted to 355 kg, a total of 108 salmons. An estimated 1,200 to 2,400 kg of salmon was caught off the Pyhäjoki estuary.

In 2003, fishermen were faced with problems from pollution load from the river, silt brought by the river to the coast, the estuary becoming shallower and seals tearing nets and eating fish in the vicinity of the coast. The number of roach was seen to be increased. *(Juntunen et al. 2004)*

6.1.8.4 Use of waters

In the sea area off Pyhäjoki, fishing mainly takes place in the village waters off Pyhäjoki, west of the Hanhikivi headland.

There is a bathing beach on the west shore of the Hanhikivi headland. In the Piehinki area, at the shore of Kultaranta west and north-east of Hanhikivi headland, there are two camping areas.

6.1.9 Vegetation and fauna

The Hanhikivi area's shore meadows are lined by a bush zone that gradually changes into primary stage alder forest, and step by step birch and other broad-leaved trees become a part of the flora. The area also has a relatively high amount of wetland developing into bogs (Heinikarinlahti, Hietakarinlahti, Liisanlampi, Rovastinperukka).

Threatened plants found in the Hanhikivi region include the populations of fourleaf mare's-tail *(Hippuris tetraphylla*) found in the Takaranta part of Hanhikivi, and the centers of Siberian primrose (*Primula nutans*) found in the Takaranta-Rovastinperukka shore meadow (both endangered).

Species of so called near threatened plants include leathery grapefern (*Botrychium multifidum*) found in the Hietalahti sands and Fries' pondweed (*Potamogeton friesii*) found in the Rovastinperukka pond. In the classification of threats, a near threatened species refers to a reverted, rare or insufficiently known species that almost meets the criteria for being threatened.

Field investigations concerning habitats of special importance in accordance with the Forest Act have been carried out in the area in the spring of 2006.

Hietakarinlahti-Rovastiperukka, located east of the Hanhikivi headland, is an important resting place for avifauna. No observations of threatened species of mammals have been made in the coastal area, nor of animal species specified listed in Annex IV (a) to the Habitats Directive.

6.1.10 Protected areas

The Hanhikivi headland of Pyhäjoki is a part of the land-uplift coast. Protection areas near the Hanhikivi headland

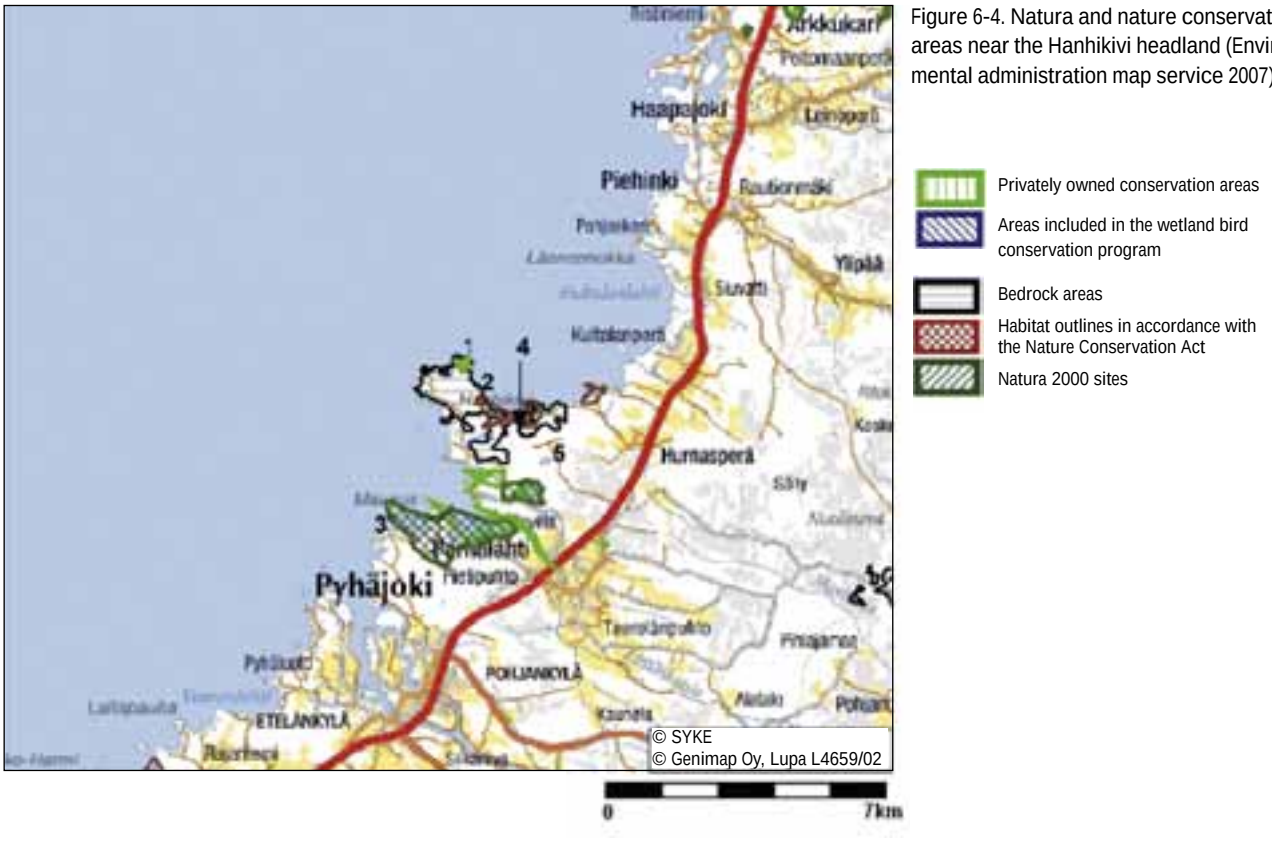


Figure 6-4. Natura and nature conservation areas near the Hanhikivi headland (Environmental administration map service 2007).

are presented in the figure below (Figure 6-4).

Most of the Hanhikivi headland has been classified as a nationally valuable bedrock area in terms of natural and landscape conservation. In terms of the uniqueness of the landscape and natural values, the bedrock areas have been classified as moderately valuable (4 on a scale of 1 to 7) and very important in terms of biologic value (4 on a scale of 1 to 4). *(Husa et al. 2001)*

There are also smaller conservation areas in the Hanhikivi headland area, such as the private nature conservation area of Ankkurinnokka in the narrow northern tip of the headland (Figure 6-4, number 1). In addition, there is the Takaranta seashore meadow and dune area that meets the criteria for protected habitat types in accordance with section 29 of the Nature Conservation Act (1096/1996), covering areas of the lower headland's northern edge (Figure 6-4, number 2).

The Parhalahti-Syölätinlahti and Heinikarinlampi areas that are part of the Natura 2000 network (FI1104201) are located south of the Hanhikivi headland (Figure 6-4 number 3). The area has been included in the Natura network in accordance with the Habitats Directive and the Birds Directive. The area is a part of the national bird wetland protection program.

Parhalahti-Syölätinlahti is rocky, low-lying land-uplift coast seashore. The Maunus shore meadow between the bays is a seashore meadow that has remained open. Mainly rush and grass grow there. This area, which is included in the Natura network, is also a bird wetland of national importance and the Maunus shore meadows a regionally important traditional rural biotope.

The Rovastinperukka and Liisanlampi gloes (Figure 6-4 numbers 4 and 5) and Hietakarinlahti are protected areas in accordance with the Water Act (1105/1996). They are also areas falling under biotopes (gloeflada and flada) listed in the Habitats directive. *(Municipality of Pyhäjoki 2007)*

In the Northern Ostrobothnia regional plan, important bird areas and the most significant areas for threatened plants that are not included in the protected areas are marked as areas of particular importance in terms of biodiversity.

The Hanhikivi area is included in a pilot project of the METSO Forest Biodiversity Program for Southern Finland "*Merestä metsäksi*" (from sea to forest) collaboration network. One of the aims of the project is to ensure biodiversity in the area voluntarily. The areas of Hanhikivi that are considered valuable have mainly been protected by so-called natural values trading. Natural values trading agreements are fixed ten-year protection agreements that are based on the voluntariness of the land owners; in accordance with them, the land owner maintains the agreed natural values at the specified site in return for funding. The valuable areas of Hanhikivi represent land-uplift coast succession forests. Natural values trading agreements have been signed in the Hanhikivi area in 2005 and 2006. Natural values trading concerns several areas in Hanhikivi, totaling approximately 150 hectares. *(Ruokanen 2006)*

Ruotsinpyhtää is located along the E18 road. Ruotsinpyhtää in January 2008.

Kampuslandet and Gäddbergsö in Ruotsinpyhtää

6.2 Ruotsinpyhtää, Kampuslandet and Gäddbergsö

6.2.1 Land use and built-up environment

6.2.1.1 Activities located in the area and its vicinity

The island of Kampuslandet and the Gäddbergsö area are located in Eastern Uusimaa, in the municipality of Ruotsinpyhtää on the coast of the Gulf of Finland. The site of the power plant location area is indicated in the figure below (Figure 6-5).

The distance to the Ruotsinpyhtää and Pyhtää church villages is approximately 15 kilometers. The center of the town of Loviisa is located some 15 kilometers away and the center of Kotka some 30 kilometers away. The distance to the village of Valko is about 10 kilometers.

The distance to the nuclear power plant in Hästholmen, Loviisa is less than 5 kilometers. There are no significant industrial plants in the Ruotsinpyhtää municipality. There is considerable amount of oil tanker shipping in the Gulf of Finland.

Figure 6-5. Preliminary location of the power plant site in the Kampslandet–Gäddbergsö area.

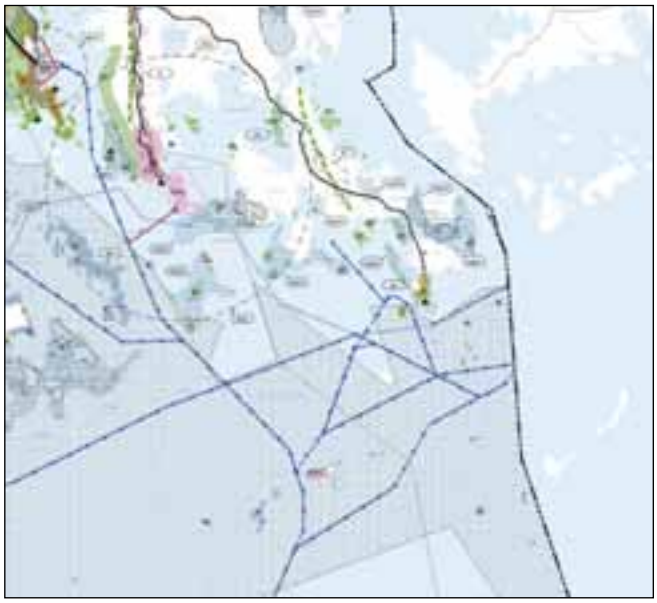


Figure 6-6. The Kampuslandet and Gäddbergsö areas in the Itä-Uusimaa regional plan (November 12, 2007).

Southwest of Ruotsinpyhtää, a little under ten kilometers away, there is the restricted zone of the Finnish Defense Forces Orrengrund site.

6.2.1.2 Land use planning

The Assembly of the Regional Council of Itä-Uusimaa approved the new total regional plan for the area on November 12, 2007. Some of the surrounding areas of the location area, the southern shores, are marked as a valuable archipelago landscape in the plan (Figure 6-6). However, this area is less than 5 kilometers away from the Hästholmen, Loviisa nuclear power plant site as well. A valuable geologic formation is indicated on the southwest tip of Gäddbergsö. There are no other special reservations in the area.

The Vahterpää-Gäddbergsö master plan, ratified in 2001 and in force, has reservations for holiday homes and farming and forestry use in the area. No detailed plans concerning the land use of the Kampuslandet area have been prepared.

6.2.2 Landscape and cultural environment

The Kampuslandet island is 2 kilometers wide from north to south and 1.5 kilometers from east to west. The Gäddbergsö headland is some 2.5 kilometers wide from east to west and approximately 3 kilometers from north to south.

Typical Eastern Uusimaa landscape comprises of glaciated rock of archipelagic islets and the coast, extensive loams of open fields, exposed bedrock areas and rocky pine stands surrounded by forest and hilly ridges. The Eastern Uusimaa region has an abundance of ridge and rock areas and morainic formations valuable in terms of nature and landscape protection. The landscape of the planned location area is at the border of inner and outer archipelagos. The typical landscape in the interior parts of the Kampuslandet island is bedrock with spruce forests in the depressions.

There are no significant cultural sites in the immediate vicinity of the Kampuslandet and Gäddbergsö areas. The nearest cultural site is the historical Kungshamn harbor site, located east/southeast of the power plant area in the area of Söderby. The site has been classified as nationally important concerning the history of civilization *(Regional Council of Itä-Uusimaa & Regional Council of Kymenlaakso 2005).*

Additionally there are some protected buildings in the vicinity.

6.2.3 People and communities

The immediate surroundings of the planned nuclear power plant site are sparsely populated. The details of settlement in the surroundings will be explored in the course of the EIA process once the more detailed location of the plant is known.

There are approximately 11,000 people living within a twenty kilometer radius of the power plant site. Parts of the municipalities of Ruotsinpyhtää, Pyhtää, Pernaja and Lapinjärvi and the town of Loviisa are located inside this area. There are approximately 1,600,000 people living within a hundred kilometer radius of the site.

There are holiday homes in the northern parts of Kampuslandet. There are some holiday homes in the Gäddbergsö area as well. There are holiday homes on the shores of islands surrounding the site.

The nearest sensitive sites, such as schools, nurseries and hospitals, will be explored and presented on a map in the assessment report.

6.2.4 Traffic

Trunk road 7 (E18) bypasses Loviisa and the town to the north. From the trunk road Saaristotie (road number 11927) separates and goes to the tip of the Vahterpää headland. Reimarsintie separates from Saaristotie, and goes to the Gäddbergsö headland.

In 2006, traffic along Saaristotie amounted to some 422 vehicles per day, of which heavy vehicles numbered six per day.

The nearest railroad leads from the Loviisa's Valko Harbor to the city of Lahti. This railway section is used by freight traffic only. The nearest passenger train station is in Kotka, some 55 kilometers away from the Kampuslandet area by road.

The nearest airport is Helsinki-Vantaa, approximately 100 kilometers away by road. There are two harbors in the nearby municipalities: Valko in Loviisa and Isnäs

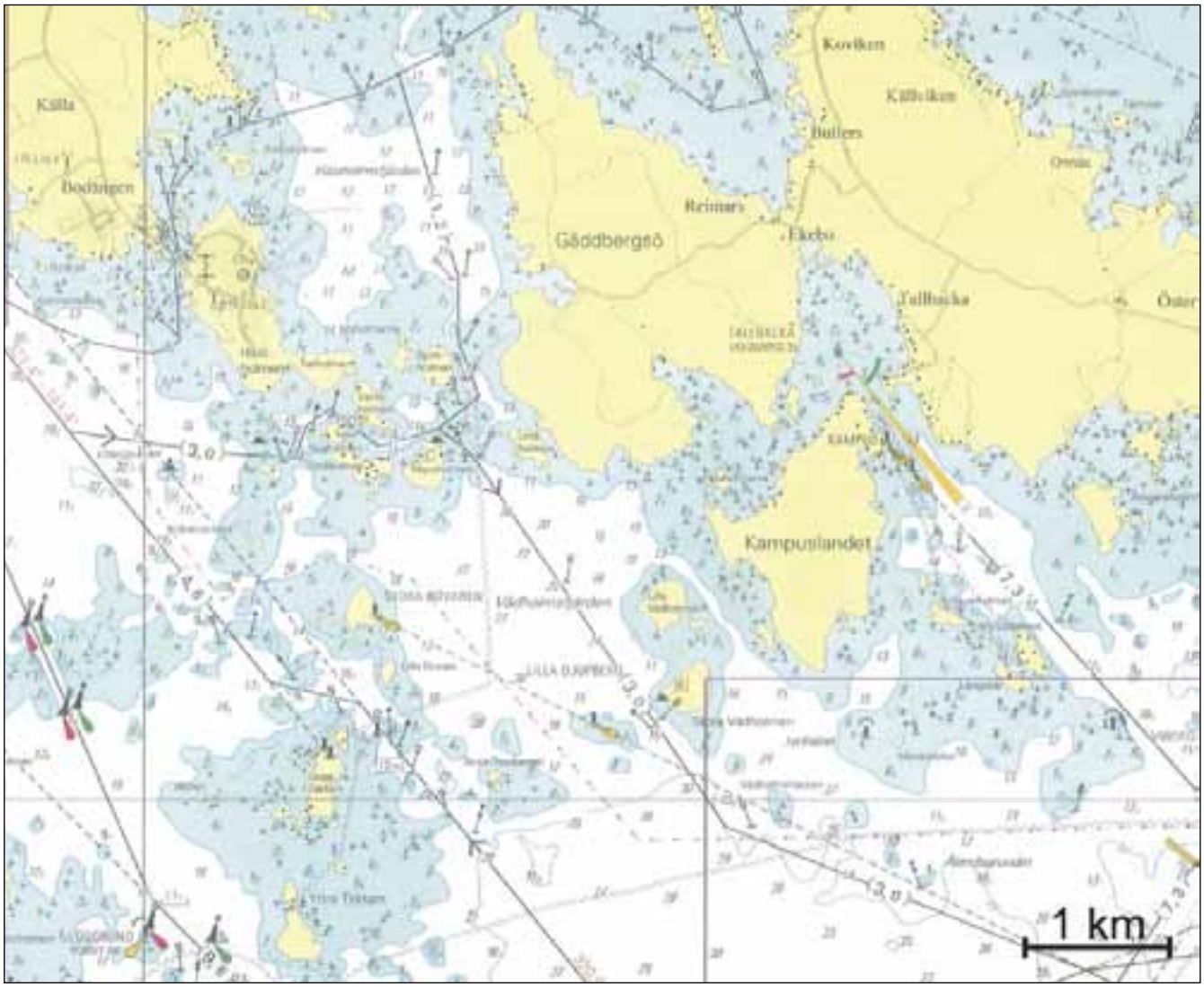


Figure 6-7. Extract from the nautical chart of the Kampuslandet-Gäddbergsö area.

in Pernaja. Additionally there are harbors in Kotka and Hamina.

6.2.5 Noise

There are no functions causing significant noise in the vicinity of the power plant site.

6.2.6 Soil, bedrock and groundwater

The typical rock type in the bedrock of Eastern Uusimaa is rapakivi granite, which is the common main rock type in the eastern parts of the province. The most common soil types are moraine and clay. There are also esker areas in Eastern Uusimaa.

Preliminary soil studies have been performed in the Kampuslandet and Gäddbergsö areas in 2007. The main rock type in the Kampuslandet island is rapakivi granite. The main minerals include feldspar (70 % to 80 %) and quartz (18 % to 28 %). The topmost parts of the highest bedrock areas are disintegrated. There are a lot of rock exposures on the island, mainly rather intact, the rock is mass structural and has few cracks. In the surrounding archipelago, low north-south rocky islets are common. Most of the ground surface is 5 to 10 meters above sea level. In a few bedrock areas, height from sea level is approximately 20 meters.

The terrain properties in the area of the Gäddbergsö area are largely similar to those in the Kampuslandet area. There are boulder areas in the central parts of the headland. The soil in the area is moraine. The rock material is homogeneous in both areas.

There are no groundwater catchment areas important for community water supply or areas suitable for this in the vicinity of the power plant location area. The nearest unclassified groundwater catchment area, Jomalsundet, is located approximately one kilometer north of Gäddbergsö. In addition, there is an unclassified groundwater catchment area at the tip of the Vahterpää headland by the island of Lehtinen.

A typical landscape in the interior parts of the Kampuslandet island is rock with spruce forests. Kampuslandet in Ruotsinpyhtää in October 2007.

6.2.7 Air quality and climate

6.2.7.1 Weather conditions

The Kampuslandet-Gäddbergsö area is located on the coast of the Gulf of Finland. The sea makes the climate milder and evens out temperature differences between different seasons.

6.2.7.2 Air quality and fallout

The air quality is on average good in Ruotsinpyhtää, since there are no significant industrial sources or energy production plants in the municipality, and additionally the emission densities of even the busiest roads are relatively low. The concentrations of nitrogen dioxide and inhaled particles are probably clearly below the limits. However, there may be occasional high particle concentrations in areas with a lot of small scale wood combustion. As for ozone concentrations, long-term objectives for the protection of health and vegetation were estimated to be exceeded in Ruotsinpyhtää in 2006.

In bioindicator monitoring in 2004, the condition of epiphytic lichen Hypogymnia physodes in Ruotsinpyhtää corresponded to the average level in Uusimaa and Eastern Uusimaa, and lichen species were somewhat more numerous than the average. The epiphytic lichen Hypogymnia physodes was healthy in the surroundings of Myllykylä and slightly damaged elsewhere in Ruotsinpyhtää. *(Kousa et al. 2007)*

6.2.8 State and use of waters

6.2.8.1 General description and hydrologic data

There is a sparse archipelago in the surroundings of the Kampuslandet island and Gäddbergsö island and relatively extensive open sea areas (Figure 6-7).

Along the coast of the Gulf of Finland and the inner archipelago, water quality is considerably affected by the pollution load from the rivers emptying into the area and direct nutrient emissions into the sea. The sheltered nature of the archipelago and the resulting low turnover of water contribute to the sensitivity of the coastal waters. The state of the Gulf of Finland also affects the quality of the coastal waters.

Kymijoki empties into the sea off Ruotsinpyhtää, as does the considerably smaller Taasianjoki river. The western branch of Kymijoki empties into Ahvenkoskenlahti, located east of Loviisa. Taasianjoki empties into Kullanlahti, from which the water goes further via Ahvenkoskenlahti to the sea.

The western branch of Kymijoki brings freshwater to Ahvenkoskenlahti at an average rate of 150 m^3/s. The river water is distributed on top of the sea water in a layer a few meters thick.

On the island of Hästholmen to the west of the location area there is a nuclear power plant comprising two units. The cooling water from this plant affects especially the Hästholmsfjärden area.

6.2.8.2 Sea area ice conditions, water quality and biologic state

In most winters, the eastern parts of the Gulf of Finland freeze at least up to Helsinki. The wind packs the ice into banks of pack ice that, due to the southeasterly wind prevailing in Finland is packed by the coast.

Based on water quality data for 2000 to 2003, most of the sea area under the Uusimaa Regional Environment Center was classified as satisfactory due to eutrophication. The estuaries of certain rivers are considerably inferior, and they have been classified as passable or poor. Elsewhere in Ahvenkoskenlahti, the state of the sea area is of a passable quality.

Even though the external nutrient load on the Gulf of Finland has decreased, no change for the better has manifested itself with regard to eutrophication, as internal nutrient load is still high due to poor oxygen conditions. The state of the sea areas off Porvoo and Kotka, for instance, has remained poor.

Fish farms cause load in the sea area off Pyhtää, located east of Ruotsinpyhtää. *(Anttila-Huhtinen 2005, Uusimaa Regional Environment Center 2007, Korpinen et al. 2006)*

Aquatic vegetation and bottom fauna

The sea bottom is muddy east of Ruotsinpyhtää, in the area of Pyhtää by the coast. The deep mud bottoms are sulphide mud smelling of hydrogen sulphide. The deepest sulphide mud bottoms have been observed, among others, in the deep area of the Ahvenkoskilahti (station P-7 16m). In the outer stations of Pyhtää, the bottom was clay, silt and gravel. *(Anttila-Huhtinen 2005)*

A sampling station that is participating in the extensive bottom fauna survey as part of the monitoring program on pollution load sources in lower Kymijoki and the sea area off it (Pyhtää-Kotka-Hamina) is located approximately three kilometers south/southeast of Kampuslandet. The most recent data from the extensive survey date from 2002.

Bottom fauna in the entire survey area, the shallow coast, comprised nearly fully of freshwater chironomids and oligochaetes. There was a very low number of species, and the bottom fauna was dominated by only a few dominant species, the *Potamothrix hammoniensis oligochaete* and larvae of the *Chironomus plumosus* and *Procladius chironomid genera*. The number of species was a little higher and mesotrophic in the immediate sphere of influence of Kymijoki, e.g. off Pyhtää. During the longer observation period preceding 2002, the state of the bottom has improved in those load vicinities from which bottom fauna could be completely non-existent as a result of intense wastewater load. At present, there are bottom fauna species indicating a eutrophic bottom in these areas and at places even species indicating a mesotrophic bottom.

Off Pyhtää, all of the outermost sampling stations were very poor or completely dead in terms of bottom fauna. For instance, no macroscopic bottom fauna of any kind was found in the sampling station closest to Kampuslandet.

The Baltic tellin stock of the area has reverted noticeably in the period from 1981 to 2002. The decline is apparently associated with the decrease in salinity and general deterioration of the state of the bottom and oxygen conditions. The alien polychaete (*Marenzelleria spp.*) has become more common in the survey area, but its number of individuals has remained rather low. *(Anttila-Huhtinen 2005)*

6.2.8.3 Fish and fishing

According to the Employment and Economic Development Center statistics, in 2003 there was one class I (more than 30 % of income) professional fisherman in the Ruotsinpyhtää area, 14 class I fishermen in the Loviisa fishing area and 16 of class III (less than 15 % of income).

In the sea area between Loviisa and Kotka, catches in 2003 were approximately 170,000 kg of Baltic herring, 530,000 kg of sprat, 20,000 kg of pike perch and 6,000 kg of pike. Catches of salmon amounted to approximately 3,000 kg.

Leisure fishing in the Ruotsinpyhtää-Pyhtää area is concentrated to Ahvenkoski and the sea area.

In 2001, there were 5,900 leisure fishermen in the Ruotsinpyhtää fishing area and 10,600 leisure fishermen in the Loviisa area.

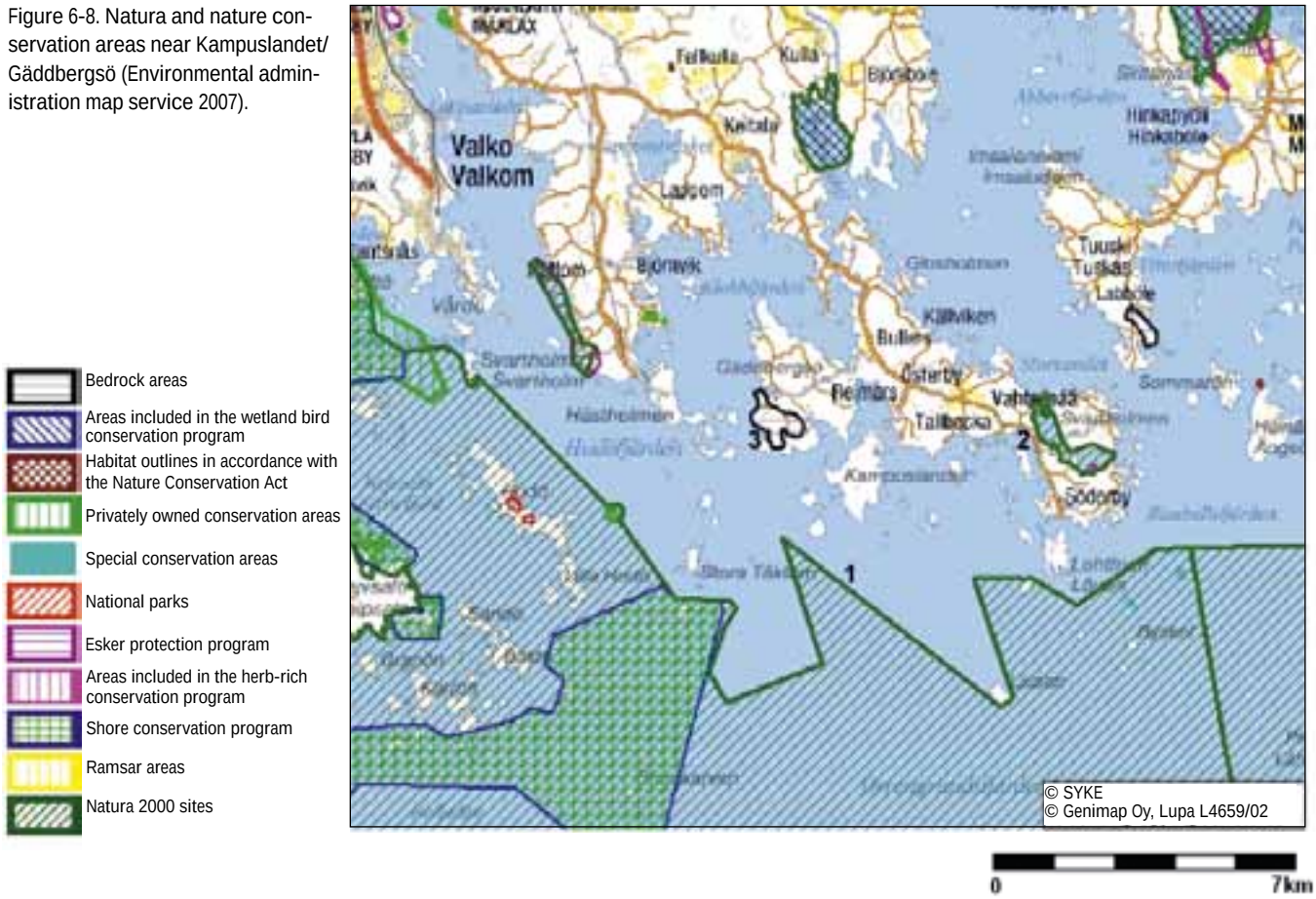
Popular fishing gear included surface net, jig, scoop net, troll and lure. The total leisure fishing catch in 2001 was 75,000 kg in the Ruotsinpyhtää area and 274,000 kg in the Loviisa area. *(Lindholm 2006)*

6.2.8.4 Use of waters

Professional and leisure fishing is practiced off Ruotsinpyhtää.

Maritime transportation and oil transportation in particular have increased quickly in the Gulf of Finland and the Baltic Sea as a whole in recent years.

Figure 6-8. Natura and nature conservation areas near Kampuslandet/ Gäddbergsö (Environmental administration map service 2007).



6.2.9 Vegetation and fauna

The Pyhtää-Ruotsinpyhtää area is located in the south boreal zone. The forests in the region vary from stunted lichen-covered rocky pine stands and dry heather-type heath forests to dryish lingonberry-type and fresh and grove-like blueberry-type heath forests. There are few broad-leaved forests. *(Suunnittelukeskus Oy 2005)*

Ahvenkoskenlahti, located northeast of the area, is important in terms of avifauna. Among others, goosander, great black-backed gull, herring gull, mew gull, little gull, Eurasian curlew, Eurasian woodcock, common snipe, common coot, great spotted woodpecker, Eurasian hobby, common black-headed gull, red-breasted merganser, common goldeneye and tufted duck nest or rest during migration in the bay.

The migration route of birds' arctic migration goes south of Vahterpää.

6.2.10 Protected areas

The protected areas near the Kampuslandet and Gäddbergsö areas are presented in the attached figure (Figure 6-8).

The closest Natura 2000 area is slightly over 1 kilometer from the Kampuslandet area, south and northwest of it: the Pernajanlahti and Pernaja archipelago sea protection area (FI0100078) included in the Natura network in accordance with the Habitats Directive and the Birds Directive (Figure 6-8, number 1). There is an abundance of water habitats in the area, and several species are included in the Birds Directive. The distance from the Natura area to the current power plant in Loviisa is 2 kilometers. The description of the Natura area mentions that expanding the Loviisa plant will not endanger the Natura 2000 area. A part of the Natura area is also included in the shore protection program. Additionally, there is a Ramsar-site, Aspskär, approximately 8 kilometers from the Kampuslandet area. The archipelago of the Eastern Gulf of Finland is an important bird area in Finland (FINIBA).

There are smallish protected areas in a headland located north of Hästholmen, west and northwest of the location area.

The coastal lakes of the Vahterpää area, approximately five kilometers east of the Kampuslandet area, are included in the Natura 2000 network (FI0100083) based on habitats of the Habitats Directive (Figure 6-8, number 2). The coastal lakes and their shores are unbuilt and the area is representative in terms of habitats. The nature conservation area Nyckelskinnsberget grove is located on the south shore of Hamnfladan in the Vahterpää area.

There is a bedrock area valuable in terms of nature and landscape protection in the Gäddbergsö headland area (Kasaberget); (Figure 6-8, number 3).

Simo is located at the lower course of the Simojoki river which flows into the Bothnian Bay. Simo in January 2008.

Karsikko and Laitakari in Simo

6.3 Simo, Karsikko and Laitakari

6.3.1 Land use and built-up environment

6.3.1.1 Activities located in the area and its vicinity

The Karsikko archipelago is located on the coast of the Bothnian Bay, approximately 20 kilometers west of the center of Simo. Karsikkoniemi is located in the southwest corner of the municipality of Simo. The southwesternmost parts of the headland are located in the area of the city of Kemi. The island of Laitakari is located off Karsikkoniemi, south of the headland, approximately 200 meters off the mainland. The power plant location area is indicated in the attached figure (Figure 6-9).

The population center of the city of Kemi is located approximately 15 kilometers from the area. The nearest larger population centers are Maksniemi and Hepola.

There is no industrial activity in the immediate vicinity of Karsikkoniemi. The Veitsiluoto industrial area and the port of Ajos are located in the city of Kemi, less than 10 kilometers from the planned power location area. Somewhat further to the south, in Kemi, there is also a

Figure 6-9. Preliminary location of the power plant location area in the Karsikkoniemi-Laitakari area.

Figure 6-10. The Karsikkoniemi area in the Western Lapland regional plan (2003).

Metsä-Botnia pulp mill.

The Karsikko location area is located in the area of the observed airspace of the Kemi-Tornio airport. There are flight paths in the immediate vicinity of the site.

6.3.1.2 Land use planning

There are several plans in force in the Karsikkoniemi area and its surroundings. In the Western Lapland regional plan, ratified in 2003, the plant area is reserved for general industrial use (Figure 6-10). The area is also marked as agricultural and forestry area.

The draft master plan for Karsikkoniemi (plan proposal October 26, 2006) is partially inconsistent with the regional plan. In the draft for the master plan of Karsikkoniemi, the undeveloped areas of Laitakari are indicated as recreational areas. In other respects, the undeveloped shore areas are indicated as agricultural and forestry areas of special environmental value.

There are areas marked as having particular importance in terms of biodiversity in the Karsikkoniemi master plan proposal, such as the shore meadows along the shore of Sauvalaisenperä and Papinkari, the Röyttänhiekka dune and sandy shore area, the Laitakari block field, the Munakallio rock and the Teponlahti shore, which is important in terms of avifauna. In the interior parts of Karsikkoniemi, Karsikkojärvi with its open marsh shore closed up as a result of land-uplift, is very important in terms of biodiversity. *(Municipality of Simo 2005)*

A shore master plan, the Maksniemi component master plan, the Maksniemi detailed plan, the Laitakari shore plan, the Kemi master plan, the Hepola detailed plan and the Ajos detailed plan extend within a 5 kilometer radius of the site. The said plans contain residential areas, the Ajos and Veitsiluoto plan an industrial area and the Ajos plan additionally a harbor area. In the newer plans, the significance of residential zones in the Karsikkoniemi area has increased. Existing municipal master plans cover the entire Kemi area.

6.3.2 Landscape and cultural environment

Karsikkoniemi is a headland approximately six kilometers long in front of the Maksniemi population center. There are holiday homes on the shores of the headland and the interior parts are in agricultural use.

There are rocky patches in various places in the Karsikkoniemi area, the vastest of them, e.g. in Laitakari and Mustakallio on the western edge of Karsikko. There are open boulder soils areas in Laitakari, Pirttirakka and Kirnuvaara, for instance. There is one sandy shore in its natural state and seashore meadow.

There is a former fishing village in the Karsikko area, classified as a site of national importance concerning the history of civilization. Most of its houses have been pulled down. There is a locally important traditional rural biotope site in the southern part of the area near the fishing harbor, the Karsikko field.

The Kirnuvaara block field has a fixed antiquity protected by the Antiquities Act, comprising of three heaps of rocks and two pits. The nearest archaeological antiquity is located in the Marostenmäki area, some 3 kilometers from the tip of Karsikkoniemi.

6.3.3 People and communities

The details of settlement in the surroundings of the nuclear power plant will be explored in the course of the EIA process once the more detailed location of the plant is known. The closest residential areas are Hepola and Marostenmäki.

There are approximately 21,000 people living within a twenty kilometer radius of the power plant location area. The city of Kemi is located inside this area. There are approximately 370,000 people living within a hundred kilometer radius of the location area.

In the Karsikkoniemi area, there are settlements in the northern parts of the area and the sea shore, especially the eastern part of the headland. There are mainly holiday homes in the vicinity of the shore. The interior parts of Karsikkoniemi are mainly uninhabited.

The nearest sensitive sites, such as schools, nurseries and hospitals, will be explored and presented on a map in the assessment report.

6.3.4 Traffic

The center of Simo is located along trunk road 4. Karsikontie (road number 19527) leading to Karsikko separates from trunk road 4 north of Karsikkoniemi. Average traffic along Karsikontie in 2006 amounted to approximately 210 vehicles per day; of them 6 were heavy vehicles.

The nearest railroad connects Oulu and Tornio. The

nearest railway station is located in Kemi, approximately 15 kilometers from Karsikko by road. The nearest airport is Kemi-Tornio, approximately 20 kilometers from Karsikko.

The nearest boat harbor is located in the Karsikko area. The nearest significant import/export port is the Port of Kemi, 25 to 30 kilometers from the Karsikko area.

6.3.5 Noise

There are no functions causing significant noise in the vicinity of the power plant location area.

6.3.6 Soil, bedrock and groundwater

The bedrock of Lapland varies very much regionally in terms of properties. Moraine is the most common soil type in Lapland. The Bothnian Bay islands are gently sloped and morainic or sandy with regard to soil. *(Regional Council of Lapland 2001)*

There is open block field and rocky patches on the Laitakari island. *(Municipality of Simo 2005)*

There are no groundwater catchment areas important for community water supply or areas suitable for this in the vicinity of the site. The nearest unclassified groundwater catchment area, the Maksniemi groundwater catchment area, is located at the base of the headland. In addition, there are unclassified groundwater catchment areas in Ajos and Ykskuusi.

6.3.7 Air quality and climate

6.3.7.1 Weather conditions

The winter is long in the Bothnian Bay, and the temperature is relatively low for the most of the year. The normal annual mean temperature at the coast measurement stations is 1 to 3°C. The Gulf Stream produces warm air masses that maintain the relatively mild winter temperate compared to other areas at similar latitudes.

The location of the Bothnian Bay in the western part of a great continent and also near the Atlantic Ocean causes the climate to vary between marine climate and continental climate, depending on the prevailing winds.

The vicinity of different climate zones causes winds to be variable in the Bothnian Bay region, especially in the winter. In the summertime, southerly and southwesterly winds prevail. Northerly winds are also common in the winter. Usually, the winds are moderate. *(Bothnian Bay Life 2007)*

6.3.7.2 Air quality and fallout

Air quality is good in the Kemi-Keminmaa area based on conducted measurements and bioindicator monitoring. Air quality monitoring has been conducted as joint monitoring since the beginning of the 1990s.

The environmental impacts of the Kemi pulp and paper industry flue gas emissions have decreased from the beginning of the 1990s onwards. Based on the 1999-2003 air quality measurements, sulphur dioxide is at a level where it is no longer an air protection problem.

6.3.8 State and use of waters

6.3.8.1 General description and hydrologic data

Karsikkoniemi is located on the coast of the Bothnian Bay. The Kemijokisuu archipelago unfolds north of the headland (Figure 6-11).

Special characteristics of the Bothnian Bay include shallowness, brackish water due to high river water input discharge, natural oligotrophy and small, phosphorus-limited basic production and scarcity of species, the species being a mix of salt, fresh and brackish water species. In addition, the Bothnian Bay is specified by quick land-uplift and the resulting constantly changing littoral of the low-lying areas. The water mass is less stratal in depth than in the southern parts of the Baltic Seas, which facilitates water mixing as far as the bottom. There is no tide and fluctuations in water level are caused by weather conditions. The low salinity of the sea water, 0.2 % to 0.4 %, makes the Bothnian Bay the least marine among the basins of the Baltic Sea.

In the Bothnian Bay, currents are mainly caused by winds, and therefore their direction and strengths vary greatly. Along the Finnish coast, there is a distinct main flow to the north. There is a high amount of water flowing between the Bothnian Sea and the Bothnian Bay. There is mainly low-saline surface water flowing out and more salinic water of the Bothnian Sea flowing in. *(Bothnian Bay Life 2007)*

Kemijoki empties into the area of the center of Kemi, west of Karsikkoniemi. There are 18 power plants on Kemijoki.

6.3.8.2 Sea area ice conditions, water quality and biologic state

Ice conditions

Due to the relatively harsh climate and low salinity, the Bothnian Bay is covered with ice in the wintertime. Strong wind, especially from the southwest, can break ice and pile it towards the Finnish side, which may hinder shipping in the area. Usually, the formation of ice begins in the inner bays in mid-November and in the middle parts of the sea in January. Typically, the ice is 70 cm thick in the north near the coast, and 30 to 50 cm in the middle parts of the sea. Ice break up begins in the beginning of May in the south and in late May in the north. Most of the Bothnian Bay is covered with ice for a minimum of 120 days per year, the northernmost parts for more than half the year.

Water quality

The surface water of the Bothnian Bay contains very little

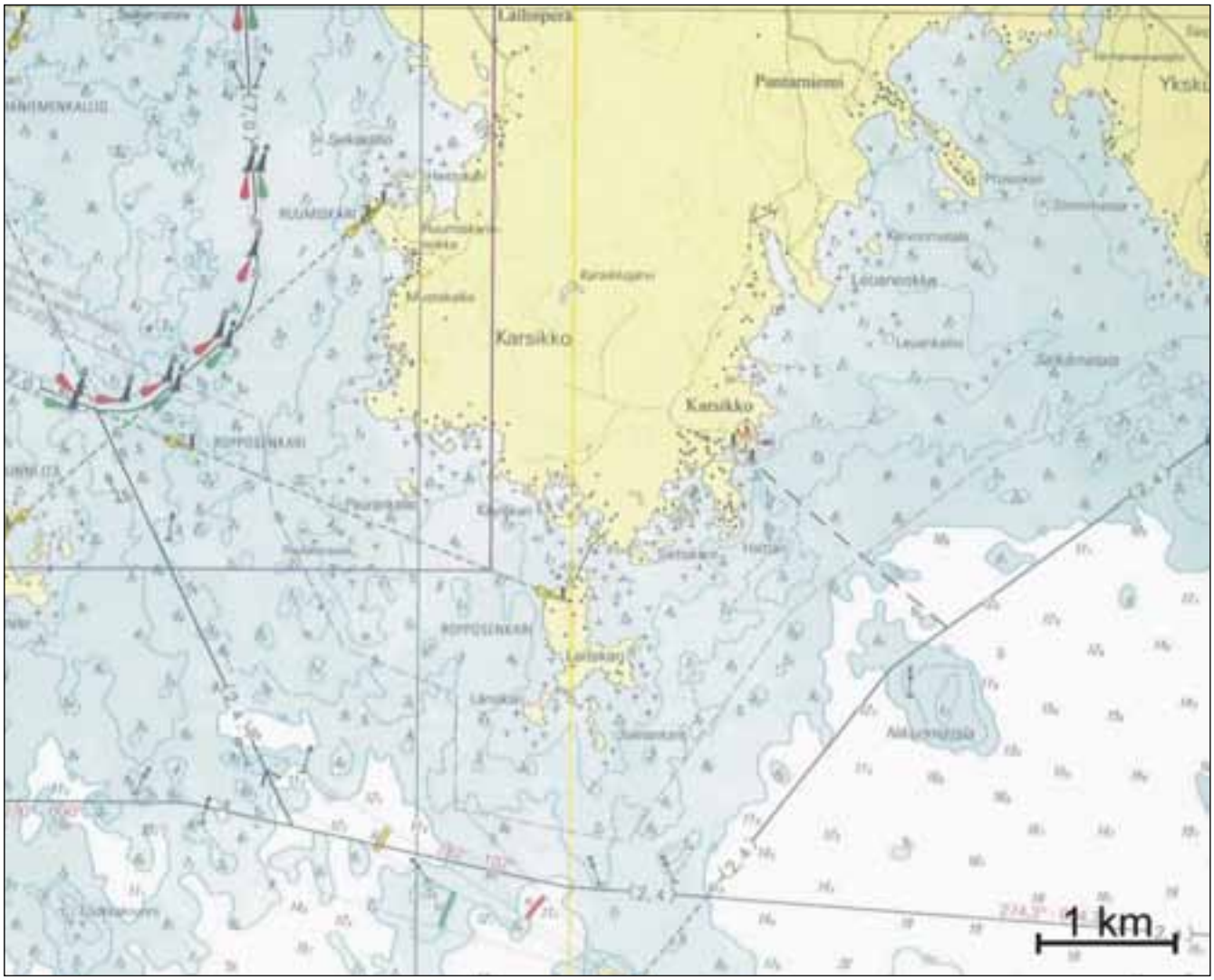


Figure 6-11. Extract from the nautical chart of the Karsikkoniemi area.

phosphorus, and therefore the sea area's basic production is phosphorus-limited. In other parts of the Baltic Sea, nitrogen is the nutrient limiting the production of phytoplankton. In fresh water systems, phosphorus is usually the limiting nutrient, and the water of the Bothnian Bay is closer to fresh water in terms of salinity.

There is no eutrophication in the open parts of the Bothnian Bay. Problems with eutrophication occur mainly in the vicinity of the coast, the archipelago, shallow coastal areas with limited water turnover and off population centers and industrial plants. No oxygen-free sea bottom areas have been observed in the Bothnian Bay in recent years. *(Bothnian Bay Life 2007)*

Water quality in the Karsikko sea area has improved considerably in recent years with improvements in wastewater processing in the Kemi area. Previously, wastewater from the Kemi industrial plants and the city has been observed to considerably deteriorate water quality in the sea area. This was evident in the sea areas west and south of Karsikkoniemi in particular. Wastewater has increased the concentrations of lignin, suspended matter and nutrients and chemical consumption of oxygen and decreased oxygen content in the wastewater distribution layer *(Municipality of Simo 2005)*

Flora and fauna

Many of the organisms living in the Bothnian Bay are living at the limits of their tolerance of salinity and temperature. The low Kvarken sill forms an obstacle to the distribution of marine species of animals and plants. In the Kvarken region, there is a thinning of the species, and Kvarken is the boundary of northern distribution for many marine species. Bladder wrack (*Fucus vesiculosus L.*), acorn barnacle (*Balanus improvisus*), common mussel (*Mytilus edulis*), common cockle (*Cerastoderma glaucum*), common eider (*Somateria mollissima*), many amphipod

The six-kilometer long Karsikkoniemi contains rocky patches, open boulder soil areas and seashore meadows. Karsikkoniemi in Simo in September 2007.

and isopods are not found in the Bothnian Bay. *(Bothnian Bay Life 2007)*

The toxicity of many metals increases as salinity decreases, and therefore some metals may be more toxic in the low-saline Bothnian Bay than in other parts of the Baltic Sea. The period of growth is short in the Bothnian Bay, and therefore fish, for instance, grow slowly and accumulate rather high toxicity levels from the environment before they are full-grown. Unlike in eutrophicated sea areas, there is less bio mass in the Bothnian Bay and there is less sedimentation, which is why toxins in the water accumulate in a smaller amount of organisms. This can be observed in the metal contents of organisms and sea bottom sediments.

Plankton production

Due to the short period of growth, the total production of phytoplankton remains at only a quarter of the plankton production of the Bothnian Sea. Mainly freshwater diatom species bloom in June in the Bothnian Bay. Inflorescence takes place only once a year, apparently due to the long ice winter, at a rather late stage. However, the ice coat of the Bothnian Bay and other arctic sea areas is not solely an obstacle to life; it also facilitates life. Certain species of phytoplankton are able to thrive within the crevices and pores of ice and the underside of ice. These are subsequently fed on by bacteria, zooplankton and other microscopic organisms. There are approximately 5 species of zooplankton in the Bothnian Bay, and among them copepods and water fleas are very important to the Baltic herring and sprat.

The low production of phytoplankton is sufficient for covering only part of the Bothnian Bay's organisms' need for energy and food. The organic matter and nutrients draining into the Bothnian Bay from river systems act as a supplementary source of energy and food to the heterotrophic organisms of the sea area. *(Bothnian Bay Life 2007)*

Aquatic vegetation

The salinity of sea water decreases gradually when going up the Gulf of Bothnia to the north, being between 2 to 4 per mille in the Bothnian Bay. Also, the species of aquatic vegetation change with the change in salinity. Marine species are gradually replaced by freshwater species as the salinity decreases. The large amounts of fresh water input into the northernmost corner of the Bothnian Bay make it possible for freshwater species to spread all the way to the outer archipelago.

At the water's edge, the vegetation of the Bothnian Bay is mainly dominated by needle spikerush (*Eleocharis acicularis*) or small Pondweed (*Potamogeton berchtoldii*) and in areas with a sandy bottom, Chara algae and horned pondweed (*Zannichellia palustris*). Deeper waters are

dominated by claspingleaf pondweed (*Potamogeton perfoliatus*) and sheathed pondweed (*Potamogeton vaginatus*), but Chara algae no longer occur. The production of larger bottom-growing algae remains at only half of what it is in the Bothnian Sea. Bladder wrack (*Fucus vesiculosus L.*) is not present north of Kvarken. Instead, the occurrence of freshwater species of moss and green algae becomes more commonplace. *(Bothnian Bay Life 2007)*

Bottom fauna

There are no mussels in the northern parts of the Bothnian Bay basin due to low salinity. The number of macroscopic bottom fauna is considerably smaller in the Bothnian Bay than in the Baltic Sea proper. The benthic amphipods *Monoporeia affinis* and *Saduria entomon* are present in the Bothnian Bay, but the populations are smaller than in the Bothnian Sea. However, *Monoporeia affinis* forms a considerable part of the bottom animal populations of the soft bottoms of the Bothnian Bay. *(Bothnian Bay Life 2007)*

6.3.8.3 Fish and fishing

Fish stocks vary with different environmental factors, such as salinity, depth or temperatures. The dominant species of the Bothnian Bay include cold water species, such as Baltic herring (*Clupea harengus L.*), vendace (*Coregonus albula L.*), whitefish (*Coregonus lavaretus*) and fourhorn sculpin (*Myoxocephalus quadricornis L.*), whereas warm water species, such as perch (*Perca fluviatilis*) and roach (*Rutilus rutilus L.*) become more commonplace towards the south. There are fewer marine species in the Bothnian Bay than in the Bothnian Sea. Many Bothnian Bay species spawn in river estuaries, since these warm up more quickly in the spring and offer more food compared to the outer archipelago. Therefore, fish stocks are very forcibly influenced by the state of river waters. Water regulation, water impurities and acidity may have a very strong impact on the fish stocks of the sea area.

The Simojoki river, which empties into the Bothnian Bay east of Karsikkoniemi, is one of the last undammed medium-sized river systems in Finland. Together with Tornionjoki, Simojoki is one of the only rivers with a wild salmon stock in the Baltic Sea area. The catches of salmon caught in Simojoki using fishing rods amounted to approximately 1,000 kg in 2003, slightly more than the previous year. In the summers preceding 2003, Simojoki catches decreased considerably more than could have been expected based on migratory fry production development. The reason for the decrease in the catch of salmon has been estimated to be e.g. an increase in the at-sea mortality of salmon. *(Finnish Game and Fisheries Research Institute 2004)*

Catches of Baltic herring have increased in the Bothnian Bay since 2000, and the Baltic herring stock has become stronger.

Effective whitefish fishing with fine-meshed scoop nets has caused most of the whitefish to be caught prior to reaching reproductive size. The regulation of whitefish net fishing by increasing the net mesh size would considerably improve the currently poor situation of sea trout in the Gulf of Bothnia as well.

There have been no significant changes in the catches of northern pike by the professional fishermen of the Bothnian Bay. The bulk of the catch of northern pike was caught from the Bothnian Sea and the Archipelago Sea, as in the preceding years.

Vendace stocks have decreased in the Bothnian Bay from the 1970s onwards, and only recently has gradual recovery of the stocks been observed. The vendace stock of the Bothnian Bay is mainly regulated by fishing, but also biologic and abiotic (such as hydrochemical factors) may have a significant impact on the size of the stock. *(Finnish Game and Fisheries Research Institute 2006, Bothnian Bay Life 2007)*

Fyke net fishing, for instance, is carried out off the Kalasatama of Karsikkoniemi and north of it.

6.3.8.4 Use of waters

Fishing is practiced off Karsikkoniemi. There are bathing beaches east of the headland and on its southwest shore.

6.3.9 Vegetation and fauna

The vegetation of the shores of Simo and the archipelago is very diverse in terms of species as well as vegetation types. Factors that contribute to the diversity include zonality of vegetation, rapid land-uplift that provides the vegetation with new and virginal space for growth, the brackish water nature of the Bothnian Bay and the cultural biotopes.

The shores of Karsikkoniemi are succession shore typical of the Bothnian Bay land-uplift coast, in which vegetation transforms from seashore meadow via reed bed and willow thicket to grey alder and finally downy birch-dominated grove-like moors when going from the shore inland. When going further up, what follows next is the spruce dominated fresh heath forest, which gradually transforms into pine-dominated dryish heath forest. The stony or rocky nature of the shores and soil of the area, and the broken shoreline partially resulting from this, however, make the zonality difficult to perceive in various places. For instance, the heath forests with broad-leaved trees in the southern part of the headland alternate with mainly willow-growing wetland depressions.

The shore meadows in the area are small and narrow due to the rocky nature of the soil. In addition to willow, juniper and rowan, there is an abundance of buckthorn growing in various places on the mainland side of the meadows. There are common reed populations on the soft-bottom shores, but common reed has not occupied a

Proper winters can still be enjoyed in the north. A winter landscape in Simo in January 2008.

particularly wide area in the vicinity.

Of the forests in the area, most have been cut down, and they are either clear-cut areas or in some developmental phase of farm forest. Original heath forest remains only in places as small patches. At moister places, forests are mixed forests or swamp forests comprising of spruce, pine and birch. In drier parts, areas of rocky and sandy soil, pine is the dominant tree species and reindeer lichen and lingonberry are dominant in the bottom layer. There is a lot of broad-leaved tree growing forest of the shores left, but at many places it has been affected by the taking of firewood caused by the dense holiday home network along the shores. Extensive broad-leaved tree forest areas can be found in the southern parts of the Karsikko headland and the biggest island in the area, Laitakari, for instance. The dominant tree species in the broad-leaved tree forests is birch. In addition, grey alder, rowan and aspen are common in the forests.

The most important marsh in Karsikko is the open marsh surrounding Karsikkojärvi, which is the result of the closing up of a lake. There is a lot of common reed growing around the lake. The marsh is nearly in a natural state.

According to information from the botanical museum of the University of Oulu, seven nationally threatened plant species have been found in the Karsikko area. Of these, the most important are field sagewort (*Artemisia campestris ssp. bottnica*) and *Primula nutans var. jokelae*, both of which are protected species. Field sagewort is classified as critically endangered and its locality is in the northeast part of the area. *Primula nutans var. jokelae* is classified as endangered. It has been found in Korppikarinnokka, Puntarniemi, surroundings of the Haahka bridge, Laitakari and Lukkarila.

Field plants grow in the meadow next to Kalasatama, for instance bluebell bellflower (*Campanula rotundifolia*), pussytoe (*Antennaria dioica*) and sheep fescue (*Festuca ovina*), but already the edges of the meadow are being dominated by great grasses and young broad-leaved trees. Occasional junipers (*Juniperus communis*) are present here and there. *(Municipality of Simo 2005)*

6.3.10 Protected areas

Protected areas near the Karsikkoniemi area are presented in the attached figure (Figure 6-12).

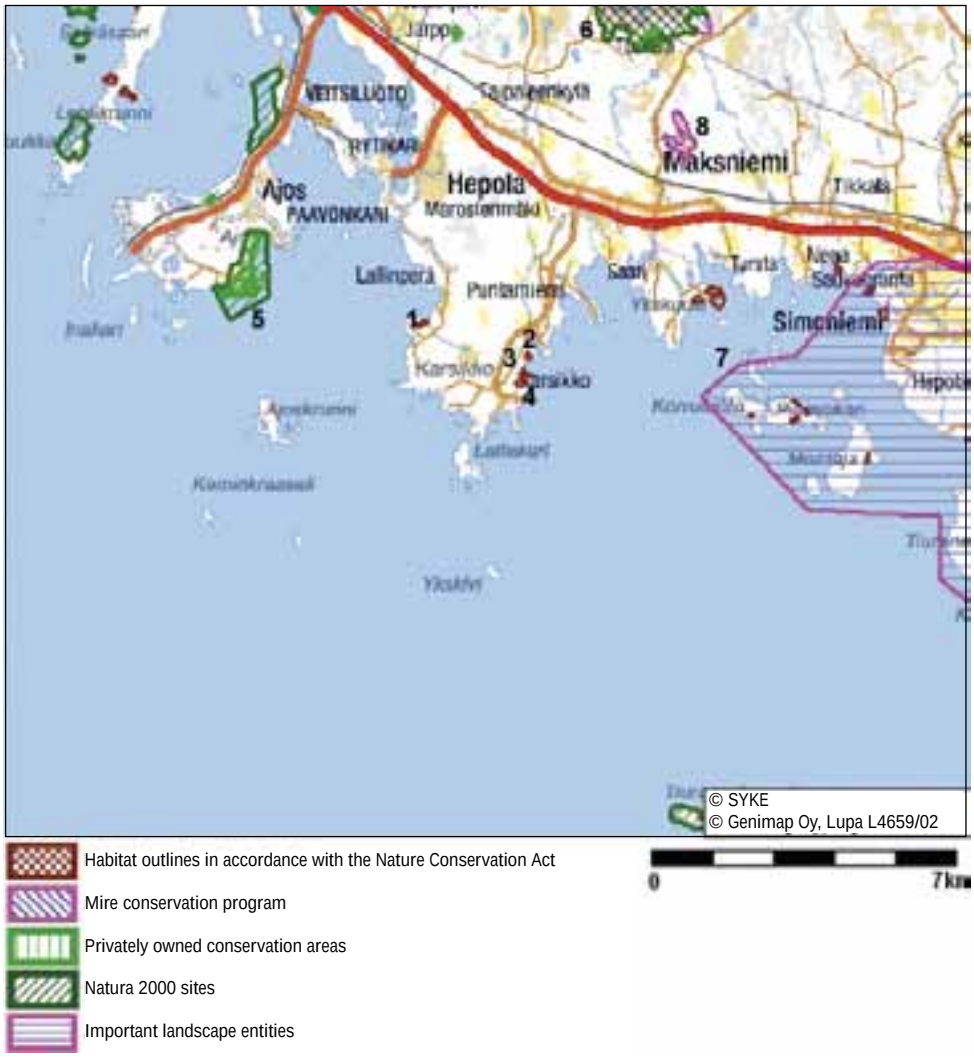


Figure 6-12. Natura and nature conservation areas near Karsikkoniemi (Environmental administration map service 2007).

There are a few smallish habitats near the Karsikkoniemi shoreline that are protected under the Nature Conservation Act. The Teponlahti seashore meadow is located on the west shore of the headland (Figure 6-12, number 1), and the Kitiniemi sandy shore and dune area (Figure 6-12, number 2), the northern Karsikko seashore meadow (Figure 6-12, number 3) and the southern Karsikko seashore meadow on the east shore in Röyni (Figure 6-12, number 4).

Sandy shore is found in Röyni, and this area is also where the largest shore meadows of the area can be found. Röyni is an important nesting and migratory resting area for birds, especially waders, as is Keppimatala, which is located north of it. The Karsikko seashore meadows are, apart from the Röyni, northern Puntarniemi and Papinkari meadows, very small in terms of area. This is due to the stony and rocky nature of the shores.

The nearest area included in the Natura 2000 network is the Bothnian Bay islands (FI 1300302) of which a part is located approximately 5 kilometers west of the planned location area (Figure 6-12, number 5). Another Natura area, the Musta-aava bog (FI1300507) is located approximately ten kilometers northeast of the site. The area is also included in the bog protection program (Figure 6-12, number 6).

The nationally important Simojoki estuary landscape protection area is located approximately 5 kilometers east of the site (Figure 6-12, number 7).

There are no sites included in nature conservation programs in the Karsikkoniemi-Laitakari area. An area included in the bog protection program is located approximately 7 kilometers to the northeast, in the Maksniemi area (Figure 6-12, number 8).

Of the important habitats referred to in section 10 of the Forest Act, the most important in the area are sands, bedrock areas, stony lands and boulder soils.

Kristinestad is the southernmost municipality in Ostrobothnia. Kristinestad in January 2008.

Norrskogen and Kilgrund in Kristinestad

6.4 Kristinestad, Norrskogen and Kilgrund

6.4.1 Land use and the built-up environment

6.4.1.1 Activities located in the area and its vicinity

There are holiday homes near the shore of the Norrskogen forest area. There are also some holiday homes on the island of Kilgrund. There is a PVO Lämpövoima Oy power plant and an oil and gas port in Kristinestad. Some large greenhouses are located south of Kristinestad. Agriculture is practiced in the surroundings of the area, and fish farming in the sea areas nearby.

The power plant location area has been roughly presented in the attached figure (Figure 6-13).

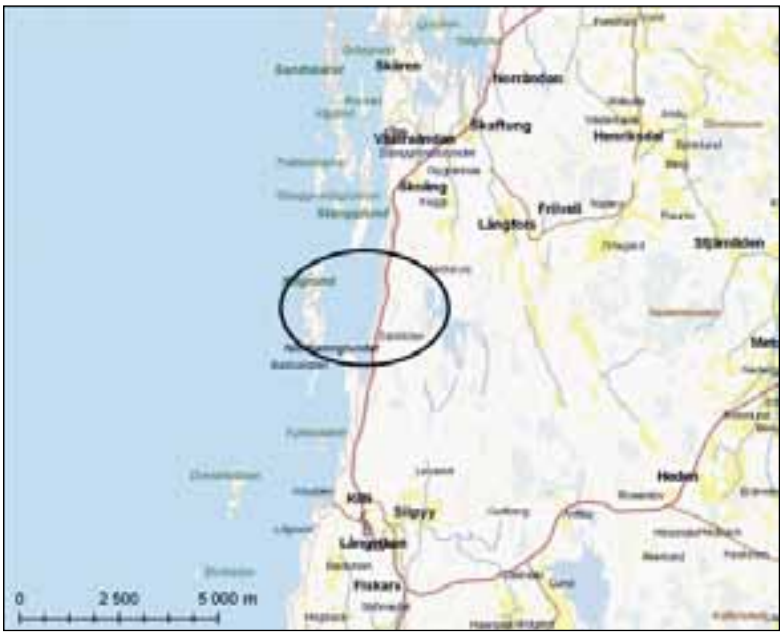


Figure 6-13. Preliminary location of the power plant location area in the Norrskogen and Kilgrund area.

6.4.1.2 Land use planning

The Norrskogen area has a regional plan that came into force in 1995. The new Ostrobothnia regional plan is at the proposal stage. A map extract from the regional plan proposal in the surroundings of Norrskogen and Kilgrund is presented in the attached figure (Figure 6-14). In addition, the area is included in the coastal master plan

Figure 6-14. Norrskogen area in the Ostrobothnia regional plan proposal (2007).

ratified in 2000. There are no special planning reservations for the Norrskogen area. The lake Storträsket in the vicinity has been reserved as a bird protection zone in the regional plan. In the Kristinestad shore master plan, the shore area is reserved for holiday homes, agricultural and forestry use and in addition there are reservations for smallish residential areas near the shoreline. The northern part of the Kilgrund island is reserved as a recreational area. The southern part is reserved as agricultural and forestry area and nature conservation area. There are areas reserved for holiday homes around the island's shore.

6.4.2 Landscape and cultural environment

Norrskogen is a forested coastal area approximately 1.0 to 1.5 kilometers wide, stretching to the lake Storträsket in the east. The Norrskogen area comprises mainly of coniferous forest and swamps and bogs, which are for the most part passable and growing trees. Broad-leaved forest is found mainly in the northwest corner of the lake Storträsket and around the Rägärdsmossen bog in the area.

Land-uplift in the Ostrobothnian coast is rapid, approximately 6 to 8 mm annually. This changes the coastal landscape quickly.

The coast is sheltered at Norrskogen. Approximately 1.5 km off it is the Kilgrund island. The island's shore parallel to the mainland is approximately two kilometers long and it is approximately half a kilometer wide. There is mainly coniferous and mixed forest on the island. There are two small overgrown gloe lakes in its interior parts. There are shallows between Kilgrund and the coast, extending the entire width of the coastal section between them.

The surface area of the Storträsket lake is approximately 63 hectares. It is rather shallow, and there is an abundance of reeds growing in it.

There are no important sites concerning the history of civilization in the immediate vicinity of Norrskogen. "Kilgrund wreck" is located in the shallows off the coast, and it is included in the shipwreck database. The Siipyy (Sideby) cultural landscape is located approximately 5 kilometers to the south. This nationally important environment in terms of the history of civilization consists of the Sideby parish village that has retained its traditional impression.

In Sideby village there is also the Kilen local museum area. Approximately 10 kilometers to the northeast is the nationally important built cultural historical environment of Härkmeri village. Approximately 5 kilometers to the north is the locally important Västraändan village area.

6.4.3 People and communities

The immediate surroundings of the planned nuclear power plant area are sparsely populated. The details of settlement in the surroundings will be explored in the course of the EIA process once the more detailed location of the plant is known.

There are approximately 2,000 people living within a twenty kilometer radius of the planned area. There are approximately 250,000 people living within a hundred kilometer radius of the area. The city of Pori, for example, is situated within a 100 kilometer radius.

The nearest sensitive sites, such as schools, nurseries and hospitals, will be explored and presented on a map in the assessment report.

6.4.4 Traffic

Norrskogen is located at a distance of approximately 15 kilometers from trunk road 8. Siipyyntie (road number 6600) leads to Norrskogen, separating from the trunk road at Träsvik. Alternatively, Siipyyntie can be accessed from the south from trunk road 8 via Hedentie (number 6601).

The average daily traffic at Siipyyntie in 2006 was approximately 372 vehicles, of which were 23 heavy vehicles.

The nearest railroad in use leads to Kaskinen, approximately 50 kilometers from Norrskogen. This railway section is used by freight traffic only.

The Karhusaari deep-water harbor, owned by Pohjolan Voima Oy, is located in Kristinestad. The port of Pori is located approximately 80 kilometers south of Norrskogen.

6.4.5 Noise

There are no functions causing significant noise in the vicinity of the power plant area.

Kristinestad has a tremendous history. Kristinestad center in January 2008.

6.4.6 Soil, bedrock and groundwater

The Norrskogen area is a part of the altitude zone 0 to 10 meters. The terrain is at its highest in the middle of the zone between Storträsket and the seashore.

The Kilgrund island is low, mainly less than 2.5 meters above sea level. Much of the west shore of the island is stony.

The parts of Ostrobothnia south of Vaasa belong to the Svecofennian schist belt of Ostrobothnia. Rapakivi granites are among the youngest granites in Finland, present in the southern part of Kristinestad. The most common soil type covering the bed rock in Ostrobothnia is moraine. There is "hill clay" moraine present in the Suupohja coastal area, south of Korsnäs. *(Regional Council of Ostrobothnia 2006)*

There are no groundwater catchment areas important for water supply or suitable for this in the area or its immediate vicinity. The nearest groundwater catchment area, Kallträskinkangas, is located approximately 10 kilometers to the southeast.

6.4.7 Air quality and climate

6.4.7.1 Weather conditions

There are both continental and maritime properties in the climate of western Finland. An evenness in the temperature is typical of a maritime climate. Annual and diurnal temperature variations are slighter in the vicinity of the sea than inland. This is evident in the prolongation of spring and autumn compared to inland, for instance. There are more sunshine hours at the coast than elsewhere in Finland. Southerly-westerly winds are dominant on the coast and at sea. *(Regional Council of Ostrobothnia 2006)*

6.4.7.2 Air quality and fallout

The most important sources of air impurities in the Ostrobothnian area are energy production, industry and traffic. In addition to the most common sulphur, nitrogen and particle emissions, energy production and industrial reductions have particularly targeted odor emissions and volatile organic compound emissions. *(Regional Council of Ostrobothnia 2006)*

Air quality is monitored with continuous measurements at the Suupohja area. Air sulphur dioxide concentrations are low in the area, but nitrogen oxide concentrations are high at times due to traffic. *(Regional Council of Ostrobothnia 2006)*

Figure 6-15. Extract from the nautical chart off Norrskogen.

6.4.8 State and use of waters

6.4.8.1 General description and hydrologic data

An extract from the nautical chart of the Norrskogen area is presented in the attached figure (Figure 6-15).

In accordance with the general 2000-2003 usability rating, the sea area off Norrskogen is satisfactory. When going from the coast to the sea, the classification does, however, quickly change into good and excellent in the open sea areas. *(Regional Council of Ostrobothnia 2006)*

6.4.8.2 Sea area ice conditions, water quality and biologic state

The majority of the load of the Ostrobothnian sea area comes from river waters. In addition to waters, the sea areas are also loaded by treated industrial and urban wastewater and fish farming. *(Regional Council of Ostrobothnia 2006)*

6.4.8.3 Fish and fishing

Fishing is a nationally important source of livelihood in Ostrobothnia. Approximately one third of professional Finnish fishermen operate in this area, and they catch approximately one half of the sea area's catch of whitefish and approximately a quarter of the catch of Baltic herring. Currently, Finnish Baltic herring fishing is concentrated in the Bothnian Bay, where the Kaskinen fishing harbor is the most important port of delivery. In recent years, however, the number of professional fishermen has tapered off sharply. Mainly coastal and archipelagic fishing using fishing vessels less than 12 meters long is carried out in the Ostrobothnian region. Compared to other parts of Finland and the Gulf of Bothnia, winter fishing from ice is still important in Ostrobothnia. This ensures all-year employment for some fishermen.

In terms of professional fishing, the most important fish species are Baltic herring and sprat, whitefish, perch and salmon. Also burbot, northern pike, smelt and cod (unloaded abroad) are important for the professional fishermen of the area.

Fish catches have varied a lot due to unnatural fluctuations in the fish stocks due to environmental changes, such as the acidification of the spawning waters and eutrophication. The profitability of fishing has decreased. *(Österbottens Fiskarförbund 2007)*

The sea has been an important source of livelihood in Kristinestad for centuries. Coast of Kristinestad in January 2008.

6.4.8.4 Use of waters

There is a boat route in the sea area between Norrskogen and the island of Kilgrund, the depth of which is 1.5 meters. The nearest fishing harbors are in Kiili in the south and Västra Ändan in the north. The nearest public bathing beaches are also located in these places.

There are fish farm pools east of the northern end of Kilgrund.

6.4.9 Vegetation and fauna

Ostrobothnia is located almost entirely in the south boreal vegetation zone of Southern Finland running along the coast. At the coast, land-uplift in particular has a significant effect on vegetation, as it maintains the continuous development of vegetation. Vegetation of land emerging from the sea follows a clear altitudinal zonality.

The Ostrobothnian coast belongs to the south boreal zone in terms of fauna as well. The archipelago off the coast is a natural boundary for the occurrence of salt water and freshwater fish species. Lapväärtinjoki empties into the sea approximately 20 kilometers north of Norrskogen. Lapväärtinjoki is one of the few rivers in Finland with a population of freshwater pearl mussel. In addition, it also has a natural stock of sea trout.

The number of large predators has been on the rise in Ostrobothnia. Wolves are regularly encountered, especially in Suupohja. The bear population has stabilized as well, and their distribution extends to the southern parts of Suupohja. Lynx habitats are located near the coast from Suupohja to the Vaasa region.

The bird species of the Ostrobothnian coast comprise of both birds migrating through Kvarken and birds nesting there. The estuaries and the archipelago provide the numerous bird species excellent nesting and resting opportunities. Also, the densest flying squirrel population in Finland can be found along the Ostrobothnian coast. *(Regional Council of Ostrobothnia 2006)*

6.4.10 Protected areas

Some of the islands located near the site are included in the Kristinestad Archipelago (FI0800134) – Natura 2000 area (Figure 6-16, number 1). Protection of the area is based on the valuable avifauna and species. The vegetation of the area is rich as well. Islands to the southeast of the area are also included in the shore protection program. The area will also be proposed to be included in the Baltic Sea and coast protected area network.

An area called Kiviringit, which is included in the esker protection program, is located approximately five kilometers southeast of Norrskogen (Figure 6-16, number 2).

Off Norrskogen and Kilgrund is an internationally important bird area (IBA), Kristiinankaupungin eteläinen saaristo.

Approximately 10 kilometers from the location area to the northeast is the Härkmeri landscape protection area.

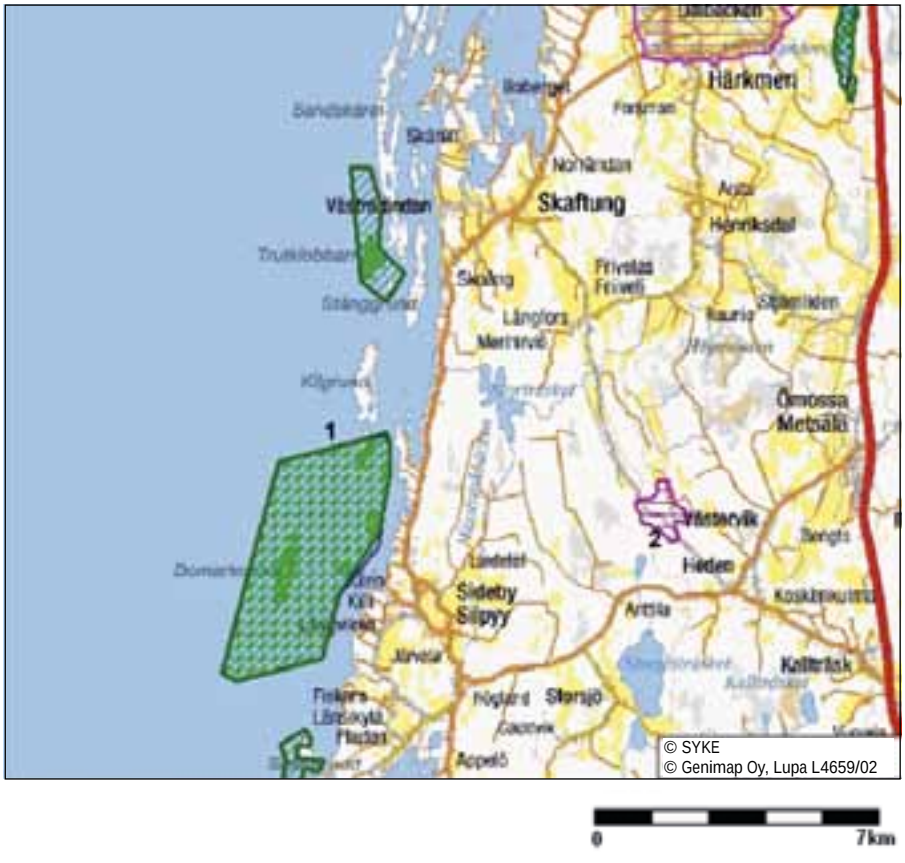


Figure 6-16. Natura and nature conservation areas near Norrskogen and the island Kilgrund (Environmental administration map service 2007).

In environmental impact assessment, environmental issues are emphasised along with technical, economic and social issues. Juhani Hyvärinen, Fennovoima's Executive Vice President, Nuclear Engineering, is presenting a modern pressurized water reactor in December 2007.

"Model calculations on the dispersal and flow of cooling waters, as well as an estimate of the impacts of thermal load on the temperatures of the area in the vicinity of the discharge site and on ice condition in different discharge site location options, will be prepared using the newest versions of three-dimensional flow, temperature and ice models. Comprehensive dispersal calculations will be obtained as the basis of water system and fishery impact assessments."

7 Environmental impact assessment and the methods used therein

7.1 General

The assessment of environmental impacts focuses on those impacts that are considered and felt to be significant. Information about issues felt important by citizens and various interest groups is obtained through interaction, resident surveys and hearing procedures, among other things.

The significance of environmental impacts is assessed on the basis of, for example, the settlement and natural environment of the observed area, as well as by comparing the tolerance of the environment with regard to each environmental burden. In addition to the investigations carried out, the existing guidelines, such as release limits for radioactive materials will be employed in assessing environmental tolerance.

The results of the environmental impact assessment will be collected in the Environmental Impact Assessment Report (EIA report). All of the relevant existing environmental data, as well as the results of the prepared environmental impact assessments, will be presented in the EIA report. The EIA report will also present a plan for the mitigation of detrimental environmental impacts.

The aim is for the observed area to be defined so large that significant environmental impacts cannot be expected to manifest themselves outside it. If, however, it becomes apparent during the assessment work that a specific environmental impact has a respective affected area larger than is estimated, the scope of the observed and affected areas will, in that connection, be redefined with regard to the impact in question. The actual definition of affected areas will thus be carried out in the environmental impact assessment report as a result of the assessment work.

The delimitations of the environmental impact assessments per impact, the environmental impacts to be investigated and the methods to be used in the assessment are presented below. The delimitation of the observed areas is specified in connection with the description of each impact assessment.

A flying squirrel survey will be conducted in March-April 2008 in the planned plant sites, and nature surveys in summer 2008.
Coast of Ruotsinpyhtää in December 2007.

7.2 Assessment of environmental impacts during construction

The environmental impacts occurring during the construction of the nuclear power plant unit will be examined separately because they differ from the impacts occurring during the operation of the power plant unit in terms of temporal duration and also with regard to other characteristics. Good recent basic data for use in assessing the impacts of the construction-time and construction site is available in Finland from, e.g. public data accumulated on the impacts during the construction of Olkiluoto 3 and the port of Vuosaari.

The EIA report will describe the construction phases of the power plant. In addition, it will describe the traffic arrangements and traffic volumes during construction, and the means of transport used. It will also explore any new routes required for traffic. The impacts of traffic during construction will be examined in the vicinity of roads leading to the power plant site by e.g. comparing construction-time traffic with the present traffic volumes and by assessing the effects of related changes on noise level, dust, traffic safety and emissions. The report will also present plans for permanent road, water supply and sewerage and other such systems.

The assessment report will examine the dust and noise impacts arising from the construction in different phases of the construction site. Other issues to be assessed include the intermediate storing and crushing of soil and rock waste, the concrete mixing plant, the utilization and disposal of various materials, construction-time waste water treatment, quality and handling of waste produced at different phases of the construction, and the environmental impacts caused by the construction of cooling water systems, loading and unloading dock and the related sea route.

The impacts of the construction on, for example, soil and bedrock, water systems, vegetation and animals will be assessed. Impacts on the social environment, such as employment, comfort and safety, will be assessed by taking into consideration the feedback received, among other things, in connection with the interaction.

The observed area for the impacts of construction activity will be the plant site and its immediate vicinity. The observed area for the construction-time traffic impacts is presented in 7.3.8 and for impacts on humans and society in 7.3.7.

7.3 Assessment of environmental impacts during operation

7.3.1 Assessment of air quality and climate impacts

The radioactive and other airborne releases arising from the operation of the planned power plant will be presented. Their impact on the environment and people will be assessed based on existing research findings.

The observed area for radioactive emissions will extend to approximately 10 to 20 kilometers from the power plant site.

In a nuclear power plant, electricity production will not cause any flue gas releases or greenhouse gas emissions. The significance of this will be illustrated by calculating the emissions that would be caused by the production of a corresponding amount of electricity using other produc-

tion methods based on combustion and the Nordic average production structure and average emission factors.

7.3.2 Assessment of water system impacts

Model calculations on the dispersal and flow of cooling waters, as well as an estimate of the impacts of thermal load on the sea water temperatures of the discharge site vicinity and on ice condition in different discharge site location options, will be prepared using the newest versions of three-dimensional flow, temperature and ice models. Their development and verification is based on applications for approximately 300 water areas in Finland and abroad. Comprehensive dispersal calculations will be obtained for the basis of water system and fishery impact assessments.

The observed area for water system impacts will be defined large enough to cover all of the essential impacts of all the assessment combinations. The observed area based on the densest grid in the mathematic model covers an area of approximately 10 to 15 kilometers from the power plant site. Information of the sea area (Gulf of Finland, Gulf of Bothnia or the Bothnian Bay), which extends further than the observed area will be attached to the model as well.

The possibilities for utilizing the heat in the cooling water will be examined.

The waste water load and radioactive releases to the sea occurring during the operation of the planned power plant will be presented. The impacts of cooling and waste water on water quality and biology, as well as on the fish population and fishery, will be assessed based on existing research data and the results of the above mentioned model calculations.

The alternatives for arranging the plant water supply and sewerage and their environmental impacts will also be examined in the assessment report.

7.3.3 Assessment of the impacts of waste and by-products and their treatment

The EIA report will describe the quantity, quality and treatment of ordinary, hazardous and radioactive waste generated at the power plant unit, and will assess the related environmental impacts. The environmental impacts of the disposal of spent nuclear fuel will not be included in this assessment.

7.3.4 Assessment of soil, bedrock and groundwater impacts

The impacts on location site soil and bedrock will be assessed according to the geography, soil quality and the area required for the plant and related facilities and underground facilities.

To assess the impact on groundwaters, the location of the power plant unit with respect to groundwater areas and the possible risks imposed on groundwaters due to construction and operation will be assessed.

7.3.5 Assessment of impacts on vegetation, animals and conservation areas

A flying squirrel survey of the planned plant location sites will be carried out in March-April 2008 and nature surveys in summer 2008. Based on the field surveys the project's direct and possible indirect impacts on vegetation and animal populations, biodiversity and their interactions will be assessed.

The question of whether the project, either individually or in combination with other projects and plans, is likely to have a significantly adverse effect on the ecological values that serve as the conservation basis of the nearest Natura areas will be reviewed in the assessment. Based on the review, it will be decided area-specifically whether a Natura Assessment according to section 65 of the Nature Conservation Act will be necessary. If necessary, the Natura assessment will be performed and attached to the report.

7.3.6 Assessment of impacts on land use, structures and landscape

The project's impacts on the landscape, present and planned land use, and the built environment will be assessed in terms of land use plans and the development of the area.

The landscape impacts will be assessed based on the plans prepared for the project, existing reviews and terrain visits, and map and aerial photography investigations. Landscape changes will be due to the power plant itself and the related activities. The characteristics of the environment in the vicinity of the location sites, as well as the sites of value in the landscape and cultural environment, will be described by means of text, maps and photographs. The question of whether the new power plant will change the landscape characteristics of the sites, from which direction the view towards the location will change significantly, and whether significant impacts on the sites of value in the landscape and environment will arise will be examined in the impact assessment. Landscape impacts will be illustrated by means of photomontages, which will be prepared on photographic templates taken from viewing points that are central in terms of people's passage. The impacts on residential and recreational areas in the vicinity of the location sites will be examined in particular.

The observed area in terms of landscape is the one where the power plants can clearly be distinguished from the landscape.

7.3.7 Assessment of impacts on people and society

Health effects, living conditions, comfort and recreational activities

The environmental impact assessment will clarify the im-

Electricity produces security and a homely atmosphere. Landscape of Pyhäjoki in January 2008.

pacts on people's health, comfort and living standards in terms of land use changes, landscape impacts, increased radiation dosages caused by radioactive releases, water system impacts, traffic impacts, traffic safety, employment impacts and noise. In addition to the above, the assessment report will also discuss the impacts of potential accidents. The starting point is the present state of the area and the change imposed on it by the project. The focus areas of the assessment will be selected based on the feedback received from the residents and commuters in the area.

A resident survey and, if required, thematic interviews will be carried out to investigate the attitudes of nearby residents towards the project and to support the assessment of social impacts. The interaction in the audit group and the discussion meetings, as well as the information obtained from various interest groups and the media, will serve as a tool for assessing the project's impact on people.

The project's impact on recreational opportunities and living comfort will be assessed, for example, on the basis of traffic volume changes and impacts on water systems (such as the ice cover). Noise impacts will be assessed based on the results of noise measurements carried out in the vicinity of current nuclear power plant areas, the design data and data and standards concerning the level of environmental noise.

The new nuclear power plant will be designed so that it will not exceed ambient noise standards in its environment. The observed area for the power plant noise impacts will extend to approximately 2 to 4 kilometers from the power plant.

The increase in radiation dosages for residents in the surrounding area caused by radioactive releases from the power plant will be assessed. Health impacts and risks will be assessed using calculations based on radiation exposure.

The impacts on people's health and comfort are assessed using the human impact assessment guidelines prepared by the National Research and Development Center for Welfare and Health (www.stakes.fi). The guidebook on the application of the Finnish law on EIA in the assessment of health and social impacts, published by the Ministry of Social Affairs and Health (Ministry of Social Affairs and Health 1999), will also be utilized in the assessment.

Regional structure, economy and employment

The assessment report will estimate the amount of direct and indirect employment created in the location region by the construction and operation of the plant. In addition, the impact of the project on the development of economic structure, the operational planning of society and the future plans of local enterprises will be assessed. The impact of the project on the regional and municipal economy will be examined in separate surveys. The data available on the impacts of other nuclear power plants in Finland will be benchmarked in the assessment.

7.3.8 Assessment of the environmental impact of traffic

The most remarkable traffic impacts will be caused during the construction of the power plant. Changes to the current traffic volumes arising from transportations, as well as the means and routes of transportation, will be presented. The noise impact and the impacts on comfort and traffic safety caused by traffic will be assessed on the basis of the traffic changes affecting residential areas. The observed areas for the traffic impacts in the environment of each location site will be specified in more detail in the course of the environmental impact assessment. The observed areas will extend to approximately 10 kilometers from the site. The required changes to the traffic arrangements in the areas, as well as their impacts, will be assessed.

7.3.9 Assessment of impacts to the energy market

The purpose of the new nuclear power plant unit is to increase the base-load power production capacity. The construction of the nuclear power plant unit will also improve Finland's independence from foreign electricity and increase supply in the electricity market. As nuclear power is characterized by the price stability of production costs,

the project will also enhance the predictability of the electricity market.

The share of the planned increase in electricity production capacity in the Nordic electricity market will be presented.

7.3.10 Assessment of the impacts of exceptional and accident situations

The bases for the safety planning of the planned power plant with regard to limiting radioactive substance releases and environmental impacts will be presented in the EIA report. It will also present the estimate of possibilities to meet safety requirements currently in force.

The environmental impacts of exceptional situations based on requirements set for a nuclear power plant will be studied in EIA report. The consequences of exceptional situations will be assessed based on the extensive research data on the health and environmental impacts of radiation. Also the impacts of possible oil accident or weather conditions as well as the effects of climate change and terrorism will also be considered in the assessment. The EIA report will also describe those safety assessments that will be carried out for the purpose of applying for a construction and operating licence pursuant to the Nuclear Energy Act, as well as other type of power plant surveillance.

In the EIA report an imaginary accident situation for each plant site, a level 6 accident according to the international INES scale (in the nuclear event scale of 1 to 7, level 6 corresponds to "serious accident"), is reviewed. Further, the accident would result a release of radioactive emissions into the environment corresponding to the limits of a serious accident set in the Government resolution 395/1991 section 12. The dispersal of the radioactive emissions released into the environment will be modeled case-by-case under either the most probable or the least favorable conditions in terms of impacts. The immediate radiation impact of an accident will be assessed in the environment of the plant within a 20 kilometer radius and radiation impact of long-range transportation within 1 000 kilometer radius.

7.3.11 Assessment of the impacts of power plant decommissioning

The assessment report will present the different decommissioning phases of the power plant, the types of decommissioning waste generated and their treatment, as well as the environmental impacts relating to them.

7.3.12 Assessment of the impacts of nuclear fuel production and transportation

The most important potential procurement sources of uranium and its enrichment and fuel manufacture will be examined and the environmental impacts of nuclear fuel production and transportation will be described according to existing studies.

7.3.13 Assessment of associated projects

The assessment observes the impacts of the construction of power lines to the national grid. The assessment report will assess the impacts of constructing or improving the required road or water transport connections.

7.4 Assessment of zero-option impacts

The zero-option is the non-implementation of the project. Fennovoima does not intend to construct other substitutive energy production, nor does it have the possibility to predict the future development of Finland's energy production and procurement structure.

Therefore, the environmental impacts of the zero-option will be assessed by reviewing the public estimates on the development of the electricity production structure and the related environmental impacts. The impacts of this option will be illustrated by calculating the emissions that would be caused by the production of a corresponding amount of electricity using other combustion-based production methods and the Nordic average production structure and average emission factors. Also the addition of so-called emission-free electricity production sources in the production structure will be taken into account.

7.5 Comparison between alternatives

The impacts of different alternatives will be compared by means of a qualitative comparison table. The major environmental impacts of different alternatives – positive, negative and neutral alike – will be recorded in this table in an illustrative and uniform manner. The environmental feasibility of the alternatives will also be assessed in this connection, based on the results of the environmental impact assessment.

The significance of the impacts of the project will be assessed by comparing the impacts of the project with standards and guidelines on emissions and quality of the environment. In addition to this, the significance of the impacts will be assessed based on the information gained from steering group, discussion events, various interest groups and the media. The opinions of residents, steering groups and operating agencies will be recorded in the EIA report.

Fennovoima acts in close cooperation with the authorities. Fennovoima's Kai Salminen, Marjaana Vainio-Mattila and Juha Miikkulainen on their way to the Radiation and Nuclear Safety Authority in December 2007.

"A decision-in-principle concerning the construction of a nuclear power plant is applied for by submitting an application to the Finnish Government. The Ministry of Employment and the Economy must obtain a preliminary safety assessment on the application from the Radiation and Nuclear Safety Authority and a statement from the Ministry of the Environment, as well as from the municipal council of each alternative municipality for the planned nuclear power plant and their neighboring municipalities."

8 Licences, permits, plans, notifications and decisions required for the project

A diagram of the nuclear power plant construction and operation permit phases is presented at the end of the section (Figure 8-1).

8.1 Land use planning

In the initial phase of the environmental impact assessment the needs for preparation and revision of the regional, general and detailed plans of each location site will be found out for a nuclear power plant and related activities, such as traffic and power transmission connections.

The implementation of the plans and any changes to the plans will be started in an appropriate phase during the course of the EIA so that the participation arrangements, studies and assessments of land use planning and the environmental impact assessment can be combined where applicable.

8.2 Environmental impact assessment and international hearing

According to the Act on Environmental Impact Assessment Procedure (468/1994) and the Decree on Environmental Impact Assessment Procedure (713/2006), the construction of a nuclear power plant requires that an environmental impact assessment procedure shall be arranged. According to the Nuclear Energy Act, the environmental impact assessment report shall be included in the application for a decision-in-principle concerning the construction of a nuclear power plant.

The assessment of transboundary environmental impacts has been agreed upon in the so-called Espoo Convention *(Convention on Environmental Impact Assessment in a Transboundary Context)*. Finland ratified this UNECE Convention in 1995. The Convention entered into force in 1997.

The parties to the Convention are entitled to participate in an environmental impact assessment procedure carried out in Finland if the detrimental environmental impacts of the project being assessed are likely to affect the country in question. Correspondingly, Finland is entitled to participate in an environmental impact assessment procedure

Climate change will make our winters shorter. Heating up a summer sauna in December 2007.

concerning a project located in the area of another country if the impacts of the project are likely to affect Finland.

8.3 Licences and permissions pursuant to the Nuclear Energy Act

8.3.1 Decision-in-principle

According to the Nuclear Energy Act (990/1987), the construction of a nuclear facility of considerable general significance shall require a government decision-in-principle in that the construction project is in line with the overall good of society.

A decision-in-principle is applied for by submitting an application to the government. The application may propose various alternatives for the location of the plant.

The Ministry of Employment and the Economy must obtain a preliminary safety assessment on the application from the radiation and nuclear safety authority and a statement from the Ministry of the Environment, as well as from the municipal council of the municipality intended to be the site of the facility and from its neighboring municipalities. The municipality in which the planned site is located must be in favor of the location of the nuclear power plant in order for the decision-in-principle to be made.

Before the decision-in-principle is made, the applicant shall, according to instructions by the Ministry of Employment and the Economy, compile a general public description of the facility, the environmental effects it is expected to have and its safety and have it checked by the Ministry. The Ministry of Employment and the Economy shall provide residents and municipalities in the immediate vicinity of the nuclear facility as well as the local authorities with an opportunity to present their opinions towards the project before the decision-in-principle is made. Furthermore, the Ministry shall arrange a public gathering in the municipality in which the planned site of the facility is located and during this gathering the public shall have an opportunity to give their opinions. Those opinions shall be made known to the government.

The government's decision-in-principle shall be forwarded to Parliament for perusal. Parliament may reverse the decision-in-principle or may decide that it remains in force as such, but it cannot amend its content.

8.3.2 Construction licence

The government grants the licence to construct and operate a nuclear facility. A licence to construct a nuclear facility may be granted if the decision-in-principle ratified by Parliament has deemed the construction of a nuclear facility to be in line with the overall good of society and the construction of a nuclear facility also meets the prerequisites for granting a construction licence for a nuclear facility as provided in section 19 of the Nuclear Energy Act. These preconditions include:

- the plans concerning the nuclear facility entail sufficient safety, and the protection of workers and the safety of the population have been appropriately taken into account;
- the location of the nuclear facility is appropriate with regard to safety and environmental protection has been appropriately taken into account;
- there is a detailed plan in the location, which allows construction of a nuclear power plant;
- the methods and plans available to the applicant for arranging nuclear fuel and nuclear waste management are sufficient and appropriate; and
- the applicant has the necessary expertise available, possesses sufficient financial prerequisites, and is otherwise considered to have the prerequisites to engage in operations safely and in accordance with Finland's international contractual obligations

8.3.3 Operating licence

The licence to operate a nuclear facility may be issued as soon as a licence has been granted to construct it, providing the prerequisites listed in section 20 of the Nuclear Energy Act are met. These preconditions include:

- the operation of the nuclear facility has been arranged so that the protection of workers, the population's safety and environmental protection have been appropriately taken into account;
- the methods available to the applicant for arranging nuclear waste management are sufficient and appropriate;
- the applicant has sufficient expertise available and, in particular, the competence of the operating staff and the operating organization of the nuclear facility are appropriate; and
- the applicant is considered to have the financial and other prerequisites to engage in operations safely and in accordance with Finland's international contractual obligations

Operation of the nuclear facility shall not be started on the basis of a licence granted until the Radiation and Nuclear Safety Authority has ascertained that the nuclear facility meets the prerequisites prescribed by law and the Ministry of Employment and the Economy has ascertained that provision for the cost of nuclear waste management has been arranged in a manner required by law.

8.3.4 Notifications pursuant to the Euratom Treaty

The European Atomic Energy Community (Euratom) Treaty requires that each Member State provides the Commission with plans relating to the disposal of radioactive waste (Article 37) and that the licencee declares to the Commission the technical characteristics of the installation for its control (Article 78) and submits an investment notification (Article 41).

8.4 Building permit

A building permit in accordance with the Land Use and Building Act (132/1999) must be applied for in connection with all new buildings. The building permit is obtained from the building permit authorities of the municipality in which the plant is located (municipal building and environment board), which, when granting the permit, will ensure that the construction plan is in accordance with the ratified local detailed plan and the building codes. A building permit is required before construction can be started. The issuance of a building permit also requires that the environmental impact assessment procedure has been completed. Beginning earth-moving and excavating work requires a landscape-work permit.

8.5 Permits pursuant to the Environmental Protection Act and the Water Act

8.5.1 Permits required for construction

A permit pursuant to the Water Act is required for constructing pier and dredging and banking work related to it or the coolant water routes, as it is for the construction of any elevated roads or bridges. The permit authority for the project is the Environmental Permit Authority of the region where the site will be located.

There are also activities at the construction site that require permits pursuant to the Environmental Protection Act, such as a rock-crushing plant or a wastewater treatment plant.

8.5.2 Permits required for operation

An environmental permit must be obtained for a nuclear power plant. A permit is required for the operations based on the Environmental Protection Act (86/2000) and the Environmental Protection Decree (169/2000) enacted on the basis of the Environmental Protection Act. An environmental permit covers all matters relating to environmental impacts, such as atmospheric and aquatic releases, waste and noise matters, as well as other related environmental matters.

The permit authority for the project is the Environmental Permit Authority of the region where the site will be located. The permit authority grants the environmental permit if the operations fulfill the requirements prescribed by the Environmental Protection Act and other legislation. In addition to the above, the project must not contradict the land use planning of the area. The environmental impact assessment procedure must also be completed before the permit can be granted.

A water permit pursuant to the Water Act (264/1961) is required for the water intake relating to the operation of the power plant.

8.6 Other permits

Other permits of relevance to this project include permits for the import and transportation of nuclear fuel, a permit for wastewater discharge into the sewage system, permits pursuant to the Chemicals Act, pressure equipment permits, and permits concerning the construction of power lines.

Permits for the import of nuclear fuel are applied for from the Ministry of Employment and the Economy and the Radiation and Nuclear Safety Authority. The permits concern import, transport routes, transport equipment and packages, as well as transport arrangements with contingency and safety plans.

Wastewater discharge into the sewage system must be agreed with the water and sewage utility of the municipality of the location, which can specify the requirements concerning the quality and volume of wastewaters discharged into the sewage system.

The Chemicals Act applies to all chemicals, but particularly chemicals with a potential danger to health or the environment. Applications for permits concerning the extensive use and storage of chemicals pursuant to the Chemicals Act (744/89, amendment 1412/92) will be submitted to the Safety Technology Authority (Tukes). Minor industrial handling and the storage of chemicals must be reported to the chief of the Fire Department of the municipality or the municipality's chemical supervisory authority.

Design, manufacture, installation, repairs and inspections of pressure equipment is regulated by the Pressure Equipment Act (869/1999). Pressure equipment includes, for instance, boilers, heat exchangers, process pipelines and pressure vessels. Hazards associated with significant boiler units must be assessed in order to ensure operation. The safety of pressure equipment and compliance with instructions is supervised by the Safety Technology Authority and in the case of a nuclear power plant, also the radiation and nuclear safety authority.

Construction of 400 kV and 110 kV transmission lines requires a building permit pursuant to the Electricity Market Act (386/95). The Energy Market Authority is the permit-granting authority.

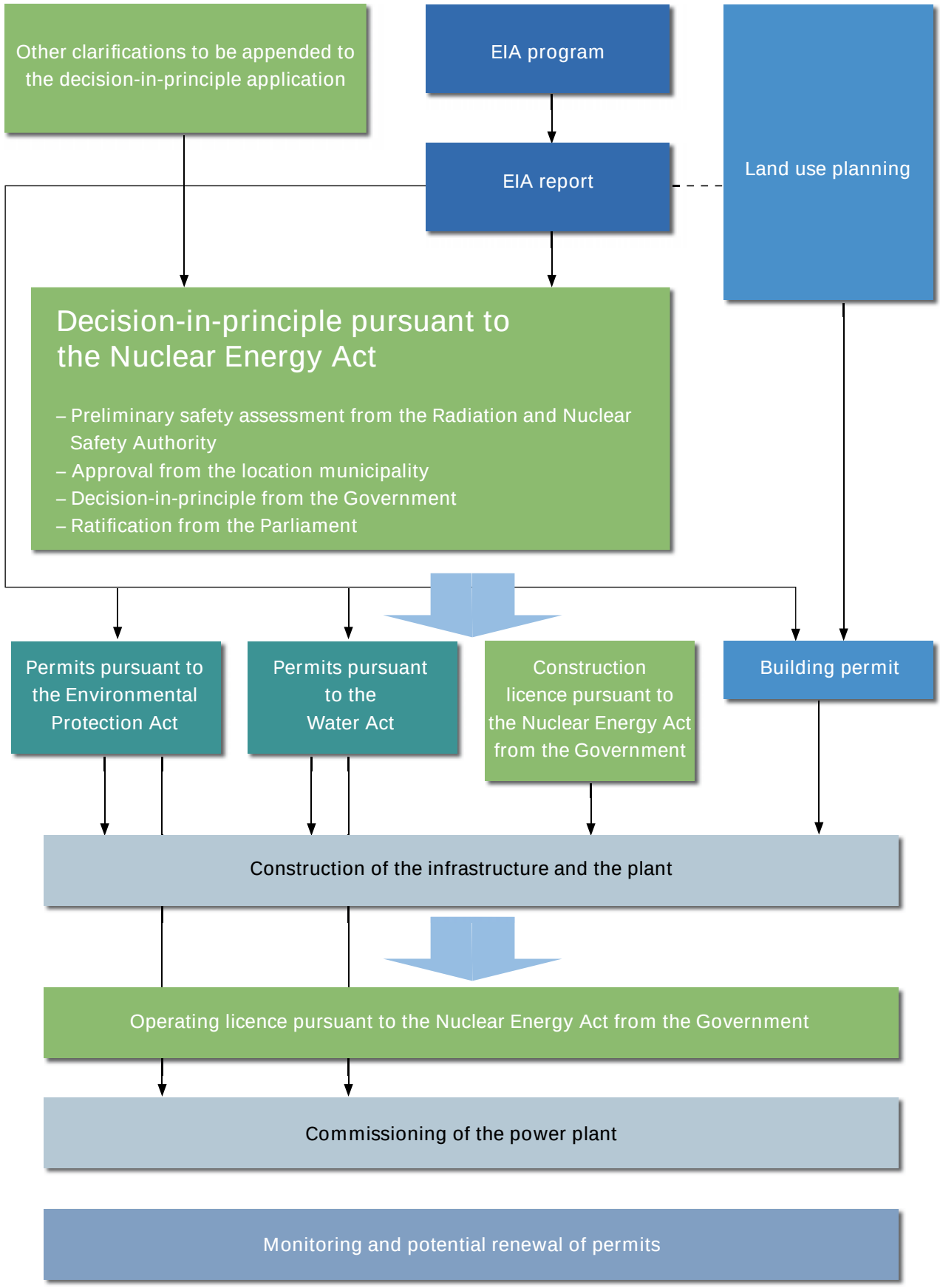
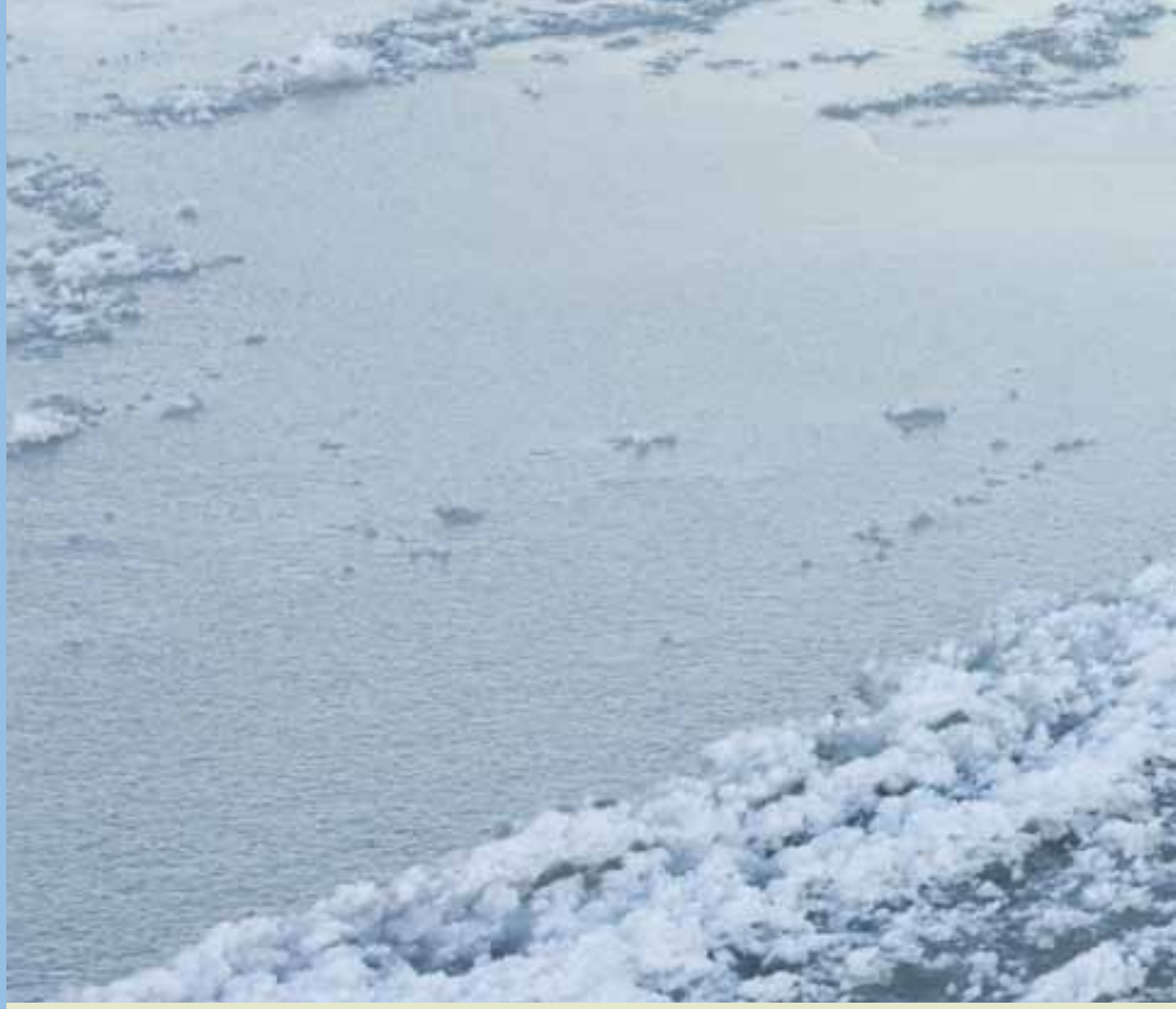


Figure 8-1. Permit procedure in the construction and operation of a nuclear power plant.



A nuclear power plant's cooling water has an impact on the water system. Early winter in Pyhäjoki in January 2008.

"A study of reduction methods and nuclear safety systems will be presented in the assessment report."

9 Mitigation of adverse impacts

The possibilities for preventing or mitigating the adverse impacts of the project, and its associated projects, by means of design or implementation will be investigated during the assessment work. A report on the mitigation measures and nuclear safety systems will be presented in the assessment report.

Finnish saunas are heated up using wood or electricity.

The significance of insecurities will be identified during the assessment as comprehensively as possible. Winter activities in Helsinki in December 2007.

“The potential uncertainty factors will be identified during the assessment work.”

10 Uncertainty factors

The available environmental data and the assessment of impacts always involve assumptions and generalizations. Furthermore, the available technical data is very preliminary at this stage. The lack of sufficient data may cause uncertainty and inaccuracy in the assessment work.

During the assessment work, the potential uncertainty factors will be identified as comprehensively as possible and their impact on the reliability of impact assessments will be considered. These issues will be described in the assessment report.

Red ochre enlivens the Finnish countryside.

The environmental impact assessment produces information to support decision-making. Skaters in Helsinki in January 2008.

“The objective of monitoring is to produce information about the project’s impacts.”

11 Project impact monitoring

A proposal for the content of the environmental impact monitoring program will be prepared in connection with the impact assessment.

The monitoring aims at:

- providing information about the project's impacts;
- investigating which changes have resulted from the project implementation;
- investigating how the results of the impact assessment correspond to reality;
- investigating how the measures for mitigating adverse impacts have succeeded; and
- initiating the required measures if significant unforeseen adverse impacts occur.

The environmental impact of not building the nuclear power plant will also be assessed. Citizens of Helsinki in January 2008.

Activity (Bq)
Activity states the number of nuclear disintegrations in a radioactive substance per one unit of time. The unit of activity is Becquerel (Bq) = one disintegration in one second.

Area definitions for the location of the power plant
Location area: a geographically indicated area where the power plant's more detailed location is to be identified.
Plant area: an area extending to a radius of about one kilometer from the power plant buildings.
Power plant site: the area where the actual power plant buildings are to be located.

Bar
The unit of pressure (1 bar = 100 kPa). The atmospheric pressure is approximately 1 bar.

Bq (Becquerel)
The unit of radioactivity meaning one radioactive disintegration in one second. The radioactive content of food products is expressed in Becquerel per mass or volumetric unit (Bq/kg or Bq/l).

Fission
Nuclear fission is the splitting of the heavy atom nucleus into two or more new nuclei, resulting in a release of a large quantity of energy, neutrons and neutrinos.

GWh
Gigawatt hour is the unit of energy (1 GWh = 1,000 MWh).

Efficiency (η)
The ratio between electrical energy produced by a power plant and the reactor's thermal energy.

Steam generator
A heat exchanger used in pressurized water plant. The steam led to turbines is generated at the steam generator's secondary side.

INES
INES stands for International Nuclear Event Scale, which categorizes events and accidents related to nuclear safety into eight categories (INES 0 – INES 7).

Ion
An ion is an electrically charged atom or molecule. Radiation that creates ions when hitting a medium is called ionizing radiation.

Ion exchange mass
A substance used to remove ion-shaped impurities in water.

Ionizing radiation
Electromagnetic radiation or particle radiation that produces free electrons and ions when hitting a medium. Ionizing radiation can break chemical links within molecules, such as cut a DNA molecule which carries cell genotypes. As a result, ionizing radiation is hazardous to health.

Isotope
Isotopes are different forms of the same element that differ from each other in relation to the number of neutrons in the nucleus and the properties of the nucleus. Nearly all elements exist as several isotopes in nature. For example, hydrogen has three isotopes: hydrogen, deuterium and tritium, out of which, tritium is radioactive.

Cooling water
Cold sea water is called cooling water, with which the steam coming from turbines is cooled back into water in the condenser (condensate). The condensate is pumped back to the reactor (a boiling water reactor) or the steam generators (a pressurized-water reactor) and it is evaporated. Cooling water is not in contact or mixed with the process waters of nuclear power plants.

Light water reactor
A reactor type where regular water is used as a cooling agent and moderator in the reactor core. The majority of the world's nuclear power plant reactors are light water reactors.

Boiling water reactor
A type of light water reactor where the water used as a cooler and moderator boils when passing through the reactor core. The steam generated in the core is led directly to rotate the turbine.

Solidification plant
A cementation or bituminization plant where liquid waste is solidified by mixing it with concrete and allowing the concrete to harden or by mixing it with hot bitumen which is then allowed to cool down.

Spent nuclear fuel
Nuclear fuel is said to be used when it has been used in energy production in the reactor and taken out of the reactor. Spent nuclear fuel contains uranium splitting products, such as cesium, and it is highly radiating.

Disposal
The permanent disposal of radioactive waste so that the disposal site does not need to be controlled and the radioactivity does not cause any danger to nature.

Thermal power (W)
The power with which the plant produces thermal energy (thermal power).

MW
Megawatt, the unit of power (1 MW = 1,000 kW).

ONKALO
ONKALO is Posiva's underground rock characterization facility for the spent nuclear fuel disposal plant located in Olkiluoto.

Pressurized water reactor
A type of light water reactor where the pressure of the water used as a cooler and moderator is kept so high that it will not boil even at high temperatures. The water passed through the reactor core transfers its heat in separate steam generators to the secondary circuit water which evaporates and is lead to rotate the turbine.

Decision-in-principle
The use of nuclear energy in the production of electricity requires a decision-in-principle made by the Finnish Government and confirmed by the Finnish Parliament. The total benefit of the society constitutes a requirement of the decision-in-principle, as well as a positive attitude of the plant's future location municipality towards the project and a positive preliminary safety assessment by the Radiation and Nuclear Safety Authority.

Base load station
A large power plant used generally at full power to satisfy the continuous minimum demand for electrical energy.

Decommissioning waste
Waste containing activity that is generated when decommissioning the nuclear power plant or other nuclear facility after utilization.

Radioactivity
Radioactive substances disintegrate spontaneously into lighter elements or transmutations of the same element with smaller energy. The process releases ionizing radiation which is either electromagnetic radiation or particle radiation.

Sievert (Sv)
The unit of radiation dosage. The greater the radiation dosage, the more probable it is that it is hazardous to health. Often, millisievert (mSv) or microsievert (µSv) units are used (1 µSv = 0.001 mSv = 0.000,001 Sv).

Defense in depth
According to defense in depth, the planning and use of nuclear power plants require several independent protection levels and methods in order to prevent accidents, to manage operating failures and accident situations and reduce the consequences of accidents.

Electric power (W)
The power with which the plant produces electrical energy that is supplied to the power grid.

Radiation
Radiation is either electromagnetic wave motion or particle radiation.

Observed area
An area defined for each environmental impact type where the environmental impact in question is studied and assessed. The extent of the observed area depends on the environmental impact under review.

TEM
Ministry of Employment and the Economy (former Ministry of Trade and Industry, KTM).

TWh
Terawatt hour is a unit of energy (1 TWh = 1,000,000 MWh).

Uranium (U)
An element whose chemical symbol is U. The volume of uranium in the earth's crust is 0.0004% of all elements (four grams in a ton). All isotopes of uranium are radioactive. The majority of natural uranium is isotope U-238, the half life of which is 4.5 billion years. About 0.71% of natural uranium is U-235 which is suitable as a fuel in nuclear power plants.

Impact area
An area where environmental impact is assessed to appear as a result of studies. The impact areas are presented in the EIA report.

Nuclear fuel
A uranium- or plutonium-content compound to be used in nuclear power plant reactors that is packed so that it can be formed into a reactor core which causes a chain reaction based on the splitting of nuclei.

Nuclear Power Plant
Nuclear power plant consists of at least one nuclear power plant unit with a reactor, one or two turbines and generators in each unit.

Commensurable carbon dioxide amount (carbon dioxide equivalent CO_2e)
Carbon dioxide equivalent stands for the commensurable unit of greenhouse gases. Different greenhouse gases have a different global warming potential. However, when all greenhouse gases are converted into carbon dioxide equivalents using the GWP factor (Global Warming Potential), their greenhouse gas emission can be summed up.

EIA
EIA stands for Environmental Impact Assessment. In addition to assessing environmental impact, the objective of the statutory EIA procedure is to improve the availability of data for citizens and their possibilities of participating in project planning and expressing their opinions towards the project.

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